TECHNOLOGY DEPARTMENT

AUGUST, 1948 TWO SHILLINGS

Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

YLONITE" *(Celluloid)*

EXOID" *(Cellulose Acetate)*

X P.V.C. *(Polyvinyl Chloride)*

X OLYSTYRENE

ACTOID" *(Casein)*

X ETHYL CELLULOSE

SOFLEX" *(Lightweight Thermal Insulation)*

BX *Leaders in Thermo-Plastics*

BX PLASTICS LTD · HEAD SALES OFFICE: HIGHAM STATION AVENUE · LONDON · E.4

Telephone : Larkswood 4491

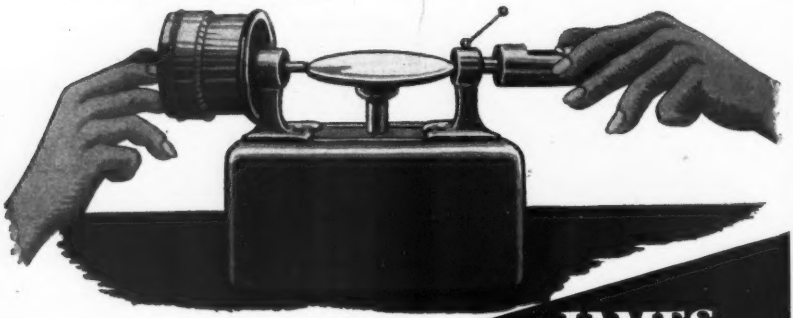
AREA SALES OFFICES: 42 Wellington Street, Sheffield. Empire House, 159 Gt. Charles Street,

Kings Corner Buildings, 1 Ridgefield,

SOLVING MOULDING PROBLEMS *in advance!*

Foreknowledge of exactly *how* a powder will behave in the moulding operation is of vital importance to the moulder. Nestorite Service anticipates every contingency in advance, and, by the use of the special apparatus illustrated on every batch, is enabled to inform the moulder what shrinkage to expect in his mouldings.

A prescience that's obviously invaluable.



A. S. HARRISON & CO. Pty. Ltd., 85 Clarence Street, Sydney. Australia.
ANDRE BERJONNEAU, Boulevard des Batignalles, 33, Paris (Ville), France.
JOSE DELCLOS, Gignas, 36 Barcelona (2), Spain.
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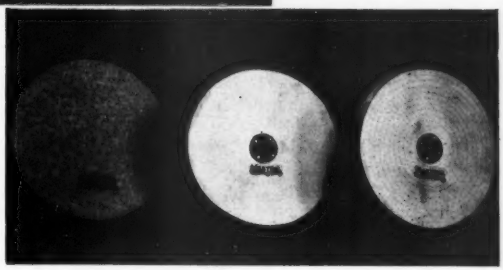
MERTON ABBEY · LONDON · S.W.19
TELEPHONE: MITCHAM 2283-7

POLISHING EQUIPMENT

PLATING EQUIPMENT

BURNISHING EQUIPMENT



CATALOGUE 'M.E.50' ON APPLICATION

MASTRAL
PLATING AND POLISHING EQUIPMENT

THE KINGSLAND ENGINEERING CO. LTD.

Phone: SHOreditch 5635 — LONDON, E.2 — 25 - 37 HACKNEY ROAD

ΦPI

Fothergill & Harvey *introduce*

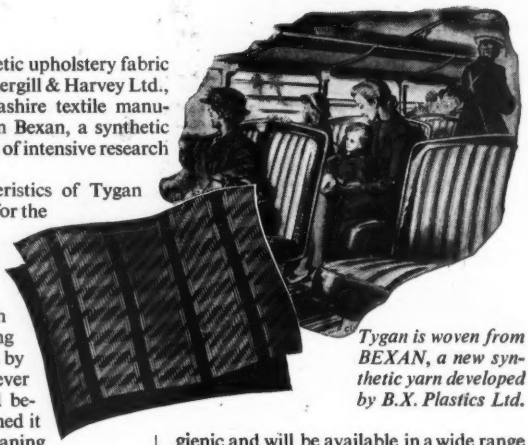
Tygan

a new woven upholstery fabric

TOUGH · WASHABLE · HYGIENIC
MOTHPROOF · FAST TO LIGHT

Tygan is a new synthetic upholstery fabric woven exclusively by Fothergill & Harvey Ltd., the old-established Lancashire textile manufacturers. It is made from Bexan, a synthetic yarn developed after years of intensive research by B.X. Plastics Ltd.

The unique characteristics of Tygan make it specially suitable for the upholstery of the seats in public transport vehicles. Tygan has outstanding resilience, toughness and abrasion resistance, which ensure excellent wearing qualities. It can be cleaned by sponging, and so need never look travel stained. And because it is so easily cleaned it speeds up the work of cleaning gangs. Tygan is fast to light, is mothproof and will not mould or rot. It is exceptionally resistant to acids, alkalis, alcohol and many other organic solvents. It has a negligible water absorption and is therefore never damp. Tygan upholsters well, is smart and hygienic and will be available in a wide range of pleasing colours and designs.



Tygan is woven from BEXAN, a new synthetic yarn developed by B.X. Plastics Ltd.

Tygan undergoes the same rigorous testing as other Tyga Textiles in the laboratories of Fothergill & Harvey Ltd. This is an assurance of the consistent high quality and serviceability of Tygan, which conforms in every respect to the highest standards of Lancashire woven productions.

● This is one of the advertisements for Tygan appearing in the Transport Trade Press.

Write for illustrated folder with patterns, quoting reference Z3 to FOTHERGILL & HARVEY LTD., Thirty-seven Peter Street, Manchester 2

"Perspex" Acrylic Resin

TRIPLEX first started shaping acrylic Resin sheets in 1936 and can therefore claim to be pioneers in this respect.

TRIPLEX were responsible for 85% of all Perspex mouldings supplied to the Royal Air Force during the war.

TRIPLEX today still offer aircraft precision standards combined with competitive prices and an excellent delivery service.

TRIPLEX carry considerable stocks of raw material and are equipped for flow production on a large scale.

TRIPLEX Plastics division has been extensively reorganised and the many difficulties arising in the change over from war to peace time production have been finally overcome.

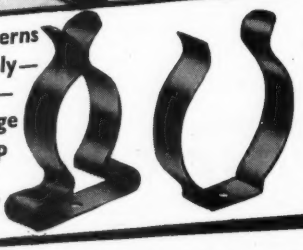
TRIPLEX can handle all your moulding and fabricating problems.

Fit "TripleX" Regd PLASTICS and be Safe

TRIPLEX SAFETY GLASS CO. LTD.
1 ALBEMARLE STREET, LONDON, W.1

LET TERRY'S SOLVE YOUR *Clip* PROBLEMS

Two stock patterns always in supply— 80 and 81— made in a range of sizes to grip from ¼" to 2"

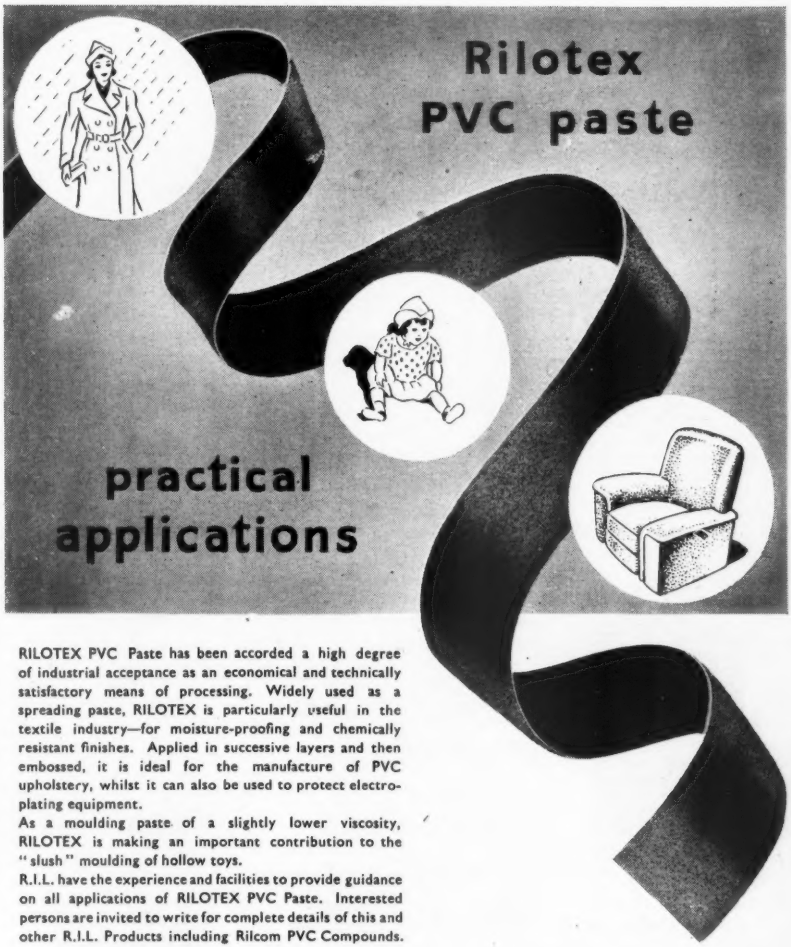


and a CLIP for drawing boards (No. 300)

We show just a few from our enormous selection of specially made clips . . . our research department can design any clip to your own specification (93 years of clip-making is at your disposal)

The most authoritative text book on springs yet published. 10/6 post free.

HERBERT TERRY & SONS LTD. REDDITCH · *London* · *Birmingham* · *Manchester*



RILOTEX PVC Paste has been accorded a high degree of industrial acceptance as an economical and technically satisfactory means of processing. Widely used as a spreading paste, RILOTEX is particularly useful in the textile industry—for moisture-proofing and chemically resistant finishes. Applied in successive layers and then embossed, it is ideal for the manufacture of PVC upholstery, whilst it can also be used to protect electro-plating equipment.

As a moulding paste of a slightly lower viscosity, RILOTEX is making an important contribution to the "slush" moulding of hollow toys.

R.I.L. have the experience and facilities to provide guidance on all applications of RILOTEX PVC Paste. Interested persons are invited to write for complete details of this and other R.I.L. Products including Rilcom PVC Compounds.

RUBBER IMPROVEMENT LIMITED

LEONEX WORKS, HYTHE RD., WILLESDEN, LONDON, N.W.10
Phone: LADBROKE 2454 Grams: "RUBBERLAND, HARLES, LONDON"

RILEX WORKS, LONDON RD., WELLINGBOROUGH, NORTHANTS
Phone: WELLINGBOROUGH 2218 Grams: "RILEX, WELLINGBOROUGH"

LONDON SALES OFFICE: 140, PARK LANE, W.1. MAYfair 2986-7-8-9

NORTHERN AREA OFFICE: Royal London House, 196, Deansgate, Manchester
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Light

Woodworking Machinery

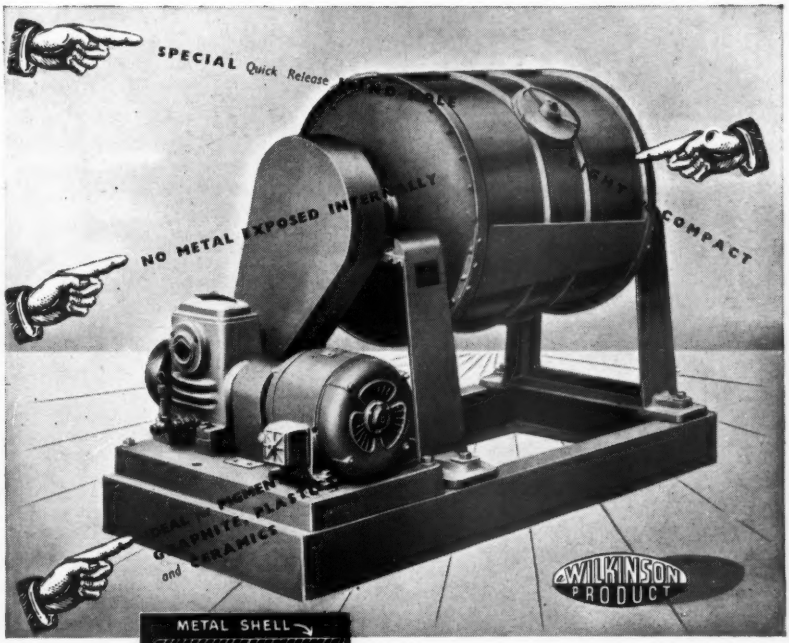
Illustrated Folder on Request

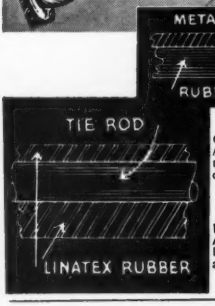
SAGAR (DEVELOPMENTS) LTD

CANAL WORKS • HALIFAX

LONDON • BIRMINGHAM

Hopwood





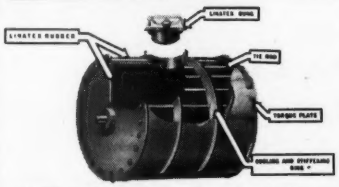
OLD METHOD. A rubber lining to the internal surfaces of the drum.

NEW METHOD. A scientific combination of rubber and metal.

Another triumph for Wilkinson Linatex engineers . . .

In mid-1945 Wilkinson Linatex first announced to engineers a Ball Mill design on new principles — the Linatex *Rubber* Ball Mill. Now from all sources has come proof of its success — especially in such industries as ceramics, plastics and pigments, graphite production, etc.

The construction of the Linatex Ball Mill is fundamentally different. Instead of a metal drum lined with porcelain or rubber, the barrel is formed by rings of Linatex 95% pure natural Rubber under compression and securely anchored by embedded tie rods. Metallic contamination of contents is impossible. Abrasion resistance is exceptional, lightness is combined with great strength and rigidity. Write for illustrated leaflet.



UNITS COMPLETE *with motor and reduction gear, or for line shaft drive. Replacement drums supplied for existing units. Sizes 1' 0" inside dia. to 3' 6" inside dia. Speeds: to suit customers' requirements.*

LINATEX 95% PURE NATURAL RUBBER **BALL MILL**

Patent No. 576410

All Enquiries to : **WILKINSON RUBBER LINATEX LTD · FRIMLEY ROAD · CAMBERLEY · SURREY**

Tel. : Camberley 1595. **Also in Canada, Australia, South Africa, U.S.A., Belgium, Malaya, etc.**

Also makers of Flexatex Hose, Linatex, and the Linatex Pump.

FOR MODERN SECONDHAND PLANT AND MACHINERY OF THE HIGHEST GRADE

From the Largest Stocks in Great Britain

Plastic Moulding and Rubber Machinery, Pans, Mixers, Filter Presses, Centrifugals, Vacuum Pumps, Stills, Condensers, and every class of Chemical Plant, Steam and Diesel Engines, Electrical Plant, Boilers, Pumps, Air Compressors, Hydraulic Plant, Locomotives, Cranes, Track and Wagons, Tanks, Steel Sections, Tubes and Fittings, and every kind of Modern Secondhand Works Equipment.

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And at Birmingham · Newcastle-on-Tyne · Sheffield · Southampton · Bath
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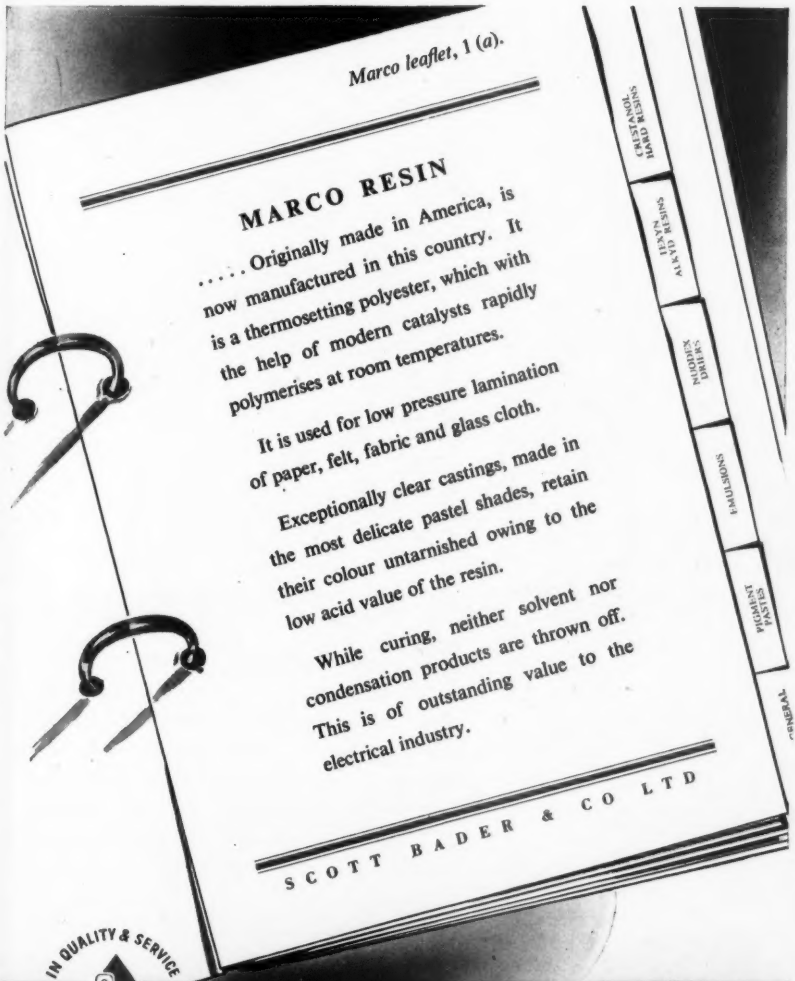

Marco leaflet, 1 (a).
MARCO RESIN
..... Originally made in America, is now manufactured in this country. It is a thermosetting polyester, which with the help of modern catalysts rapidly polymerises at room temperatures.
It is used for low pressure lamination of paper, felt, fabric and glass cloth.
Exceptionally clear castings, made in the most delicate pastel shades, retain their colour untarnished owing to the low acid value of the resin.
While curing, neither solvent nor condensation products are thrown off. This is of outstanding value to the electrical industry.
SCOTT BADER & CO LTD
PRESTANOL HARD RESINS
LEVYN ALKYD RESINS
PUDDERS DRIERS
EMULSIONS
PIGMENT PASTES
GENERAL

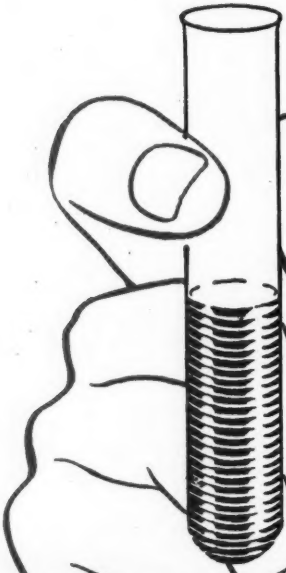
IN QUALITY & SERVICE
SB
- FOREMOST -

SYNTHETIC RESINS

109, KINGSWAY, LONDON. W.C.2

Tel.: HOLborn 3691

● *Head Office & Works :* WOLLASTON · WELLINGBOROUGH · NORTHAMPTONSHIRE



AT EVERY IMPORTANT STAGE

of its manufacture every batch of every Monsanto chemical is carefully checked by highly specialised control chemists. Then on top of all that, not a pound or a pint of a Monsanto product is passed for dispatch or further use until it has undergone the most critical analytical tests. For full details of Monsanto's complete range of chemicals, write to: Monsanto Chemicals Limited, Victoria Station House, London, S.W.1.

MONSANTO CHEMICALS

PHENOL... CRESYLIC ACIDS... PHTHALIC ANHYDRIDE (flake)... DIETHYL PHTHALATE... DIMETHYL PHTHALATE... DIBUTYL PHTHALATE... AROCLORS (chlorinated diphenyls)... SANTOLITES (speciality resins)... SANTICIZERS (speciality plasticisers)... FIBESTOS (cellulose acetate)... BENZOIC ACID... SALICYLIC ACID... LUSTRON (polystyrene moulding crystals)...

SERVING INDUSTRY WHICH SERVES MANKIND

Necessarily, optical instruments have to be of the highest standard of workmanship. Components must fit perfectly, without suspicion of "shake" or tightness.

Because of the impeccable accuracy and fine finish of our work the makers of the binoculars illustrated use the Mouldings displayed for case-work of their glasses.

It is a "precision" job through and through and a fair example of the supreme quality of the plastic mouldings manufactured in our works at Stamford Bridge, York.

★ If what you require can be made in Plastic, we can supply your needs to your complete satisfaction. May we look for your enquiries?

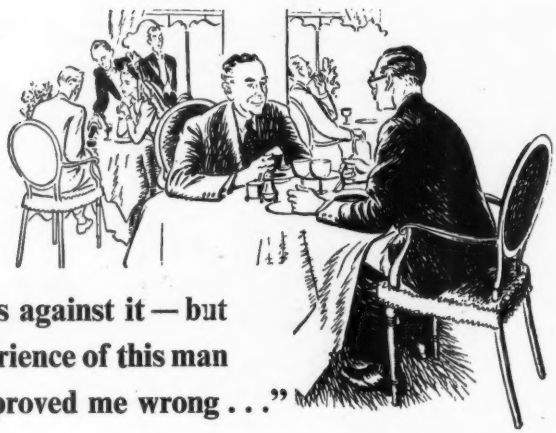
Derwent Plastics LTD.

MINSTER MOULDINGS

STAMFORD BRIDGE, YORK • TELEPHONE, 54 STAMFORD BRIDGE.

E.I.H.

C



"I was against it — but experience of this man has proved me wrong . . ."

"I'LL admit I was rather against taking on anyone over 40 for an executive job. You know—old dogs, new tricks, and all the rest of it. . . .

"But this man I mentioned is older—and he's proved me wrong. I'd forgotten what a tremendous asset experience can be! He got the hang of our business in no time; and he has a general grasp and judgement you couldn't expect from a youngster. To watch his experienced way of tackling a problem is fine training for the young chaps in his department who will one day succeed him.

"Yes, the Appointments Office suggested him — added him to their 'short list' because of his impressive record. I'm exceedingly glad they did. It's an instance of the intelligent way they help you in finding the best available man for the vacancy. The 14 Regional Appointments Offices are linked by teleprinter, so you get the pick of all their regional registers. And they've already done the preliminary interviewing and sifting before they suggest a few candidates, all 'probables,' for you to see if you like. I've found the system quick, efficient, and human, and I'd recommend any employer wanting a really good man to see what his nearest Appointments Office can do."

Hundreds of employers have commended the efficient service given by the fourteen Regional Appointments Offices. They are today's logical starting-point in the recruitment of high-grade staff, whether the need is for men and women already experienced and who are sometimes holding responsible posts, or for promising younger candidates to train.

Your nearest Appointments Office "matches men with jobs" in the executive, managerial and administrative field. If you do not know the address, any local office of the Ministry of Labour will put you in touch at once. But for highly qualified technical and scientific personnel — engineers, scientists, architects, etc. — appointments are dealt with centrally, in London, by the specialist staff of the *Technical and Scientific Register*, York House, Kingsway, W.C.2.

Since VE-day, the Appointments Department has successfully filled over 68,000 responsible posts. If you have a staffing problem, your Regional Appointments Office is ready to help.

14 linked Appointments Offices cover the Nation's potential executive manpower

Issued by the Ministry of Labour and National Service, Appointments Department, 1-6 Tavistock Sq., London, W.C.1

"*Blessings on Lorival! . . . Who'd have thought it could be made in plastics! . . . They've taken a load off my mind.*"

Our plastic and ebonite moulding service is at present restricted to export and essential products. Our products include parts for batteries, radio sets, water meters and sanitary ware for *EXPORT* and mouldings for textile machinery, miners' lamps and electrical equipment for *ESSENTIAL* industries. If you are a manufacturer concerned with the '*two E's*', our service — the design, tooling and quantity production of high quality mouldings — is at your disposal.

U E L

LORIVAL PLASTICS

UNITED EBONITE AND LORIVAL LIMITED, LITTLE LEVER, NEAR BOLTON, LANCS.

press on chaps!

Chasing the elusive dollar is now a national necessity. For our part we are helping manufacturers to face their export targets. To help them press on we have a mighty array of presses ranging up to 1500 tons. With these and our natural fondness for compression moulding we can tackle anything from smallest components to large sized housings. If you are stuck for a part or think that your product could be made quicker or better in plastics let us help you press on.

If you want to know about plastics ask **Ashdowns**

In addition to making mouldings, we have a special department for fabricating "PERSPEX," and we make "ASHLAM" electrical insulation boards, which, incidentally, are exceedingly good.

"ASHLAM" is the registered trade mark of Ashdowns Ltd. "PERSPEX" is the registered trade mark of I.C.I. Ltd.

ASHDOWNS LTD., ECCLESTON WORKS, ST. HELENS. PHONE: ST. HELENS 3206

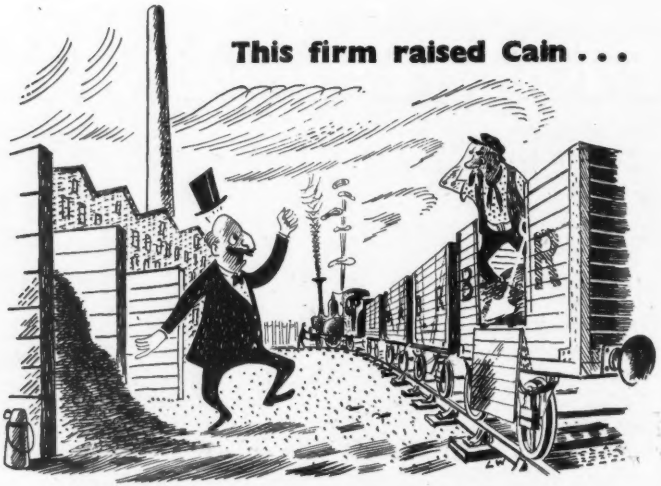
Ashdowns is a subsidiary of Pilkington Brothers Ltd.

FIRTH-BROWN

"MITIA" CARBIDE TIPPED

FIRTH BROWN TOOLS LIMITED, SHEFFIELD

SEE OUR EXHIBIT, MACHINE TOOL & ENGINEERING EXHIBITION, AUG. 28 - SEPT. 11



but the slacks raised steam!

A certain firm had always used good graded coals for boiler fuel, although there was no apparent reason why ordinary boiler slacks should not be used. But when these were supplied, complaints of inability to raise steam followed post-haste.

The Ministry's Stoker Demonstrator was sent to investigate. He found that the flues had not been cleaned for five years and were so choked up that, even with graded coal, there was hardly sufficient draught! Cleaning the flues cured the trouble.

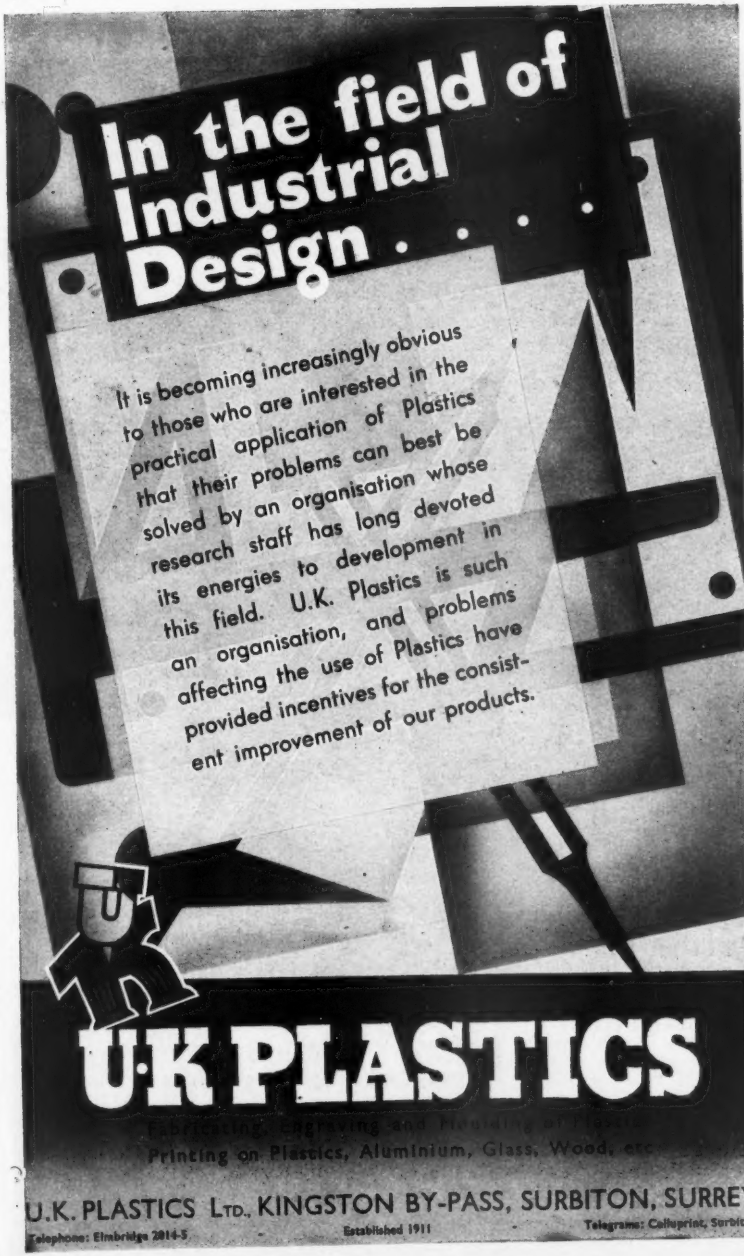
Of course *you* wouldn't make such a mistake, but wouldn't it be a good idea just to check over your plant? It is the simple errors that are so often overlooked —whether they are old legacies of the past that have been allowed to continue,or newer bad habits that have crept in unnoticed.

Why not call in the Ministry's Fuel Engineer? His services are free, and, while you are under no obligation to accept his advice, you would do well to consider it carefully. Even if your house *is* in order, it is nice to know it!

YOUR REGIONAL FUEL OFFICE

REGION	ADDRESS	TELEPHONE
Northern	Government Buildings, Ponteland Road, Newcastle-on-Tyne, 5	Newcastle 28131
North-Eastern	Century House, South Parade, Leeds, 1	Leeds 30611
North-Midland	Castle Gate House, Castle Gate, Nottingham	Nottingham 46216
Eastern	Shaftesbury Road, Brooklands Avenue, Cambridge	Cambridge 56268
London	Mill House, 87/89 Shaftesbury Avenue, W.1	Gerrard 9700
South-Eastern	95, High Street, Rochester	Chatham 3487
Southern	Whiteknights, Earley, Reading	Reading 61491
Wales	27, Newport Road, Cardiff	Cardiff 9234
South-Western	12/14, Apsley Road, Clifton, Bristol, 8	Bristol 38223
Midland	Temporary Office Buildings, Hagley Road West, Birmingham, 17	Bearwood 3071
North-Western	Burton Road, West Didsbury, Manchester, 20	Didsbury 5180-4
Scotland	145, St. Vincent Street, Glasgow, C.2	Glasgow City 7636
Scotland	51, Cockburn Street, Edinburgh, 1	Edinburgh 34881
Scotland	1, Overgate, Dundee	Dundee 2179

ISSUED BY THE MINISTRY OF FUEL AND POWER


In the field of Industrial Design . . . .
It is becoming increasingly obvious to those who are interested in the practical application of Plastics that their problems can best be solved by an organisation whose research staff has long devoted its energies to development in this field. U.K. Plastics is such an organisation, and problems affecting the use of Plastics have provided incentives for the consistent improvement of our products.
U·K PLASTICS
Printing on Plastics, Aluminium, Glass, Wood, etc.
U.K. PLASTICS LTD., KINGSTON BY-PASS, SURBITON, SURREY
Telephone: Elmbridge 2814-5
Established 1911
Telegrams: Calleprint, Surbiton

The Modern 'Drummer'

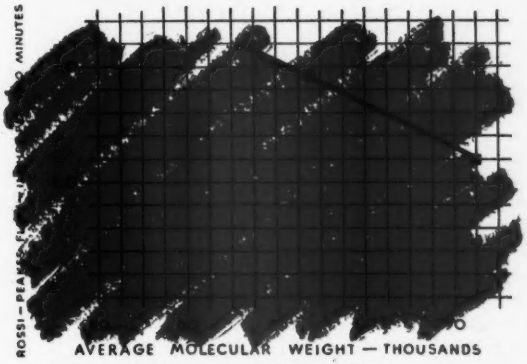
Once upon a time the 'drummer,' fixing his foot firmly in the crack of the door, sold his goods by blarney and persistence. Salesmanship is much more subtle to-day—and more rewarding. Goods packaged in crystal-clear cellulose acetate keep on the move through their sheer attractiveness. We welcome your enquiries for this inviting, versatile substance. There is no "if" about getting it. You can get it now!

DUFAY-CHROMEX LTD., 14-16, Cockspur St., Westminster, London, SW1

THE FLOW VALUES OF MONSANTO Lustron

POLYSTYRENE MOULDING CRYSTALS

In the graph below variations of Rossi-Peakes Flow at 275°F and 1500 P.S.I. are plotted against average molecular weight of Lustron. It is clearly demonstrated that the flow of Lustron decreases with the increase in molecular weight. "Cold flow" is extremely low—parts moulded in Lustron "stay put".



Variations of Rossi-Peakes Flow at 275°F and 1500 P.S.I. with average Molecular Weight of Lustron.

MONSANTO CHEMICALS

QUICK FACTS ABOUT LUSTRON . . . Low cost per pound . . . Lightweight . . . Faster moulding . . . New brilliance and clarity . . . No taste or odour . . . High dimensional stability . . . Good chemical resistance . . . Excellent electrical qualities . . . Gay colour range.

Write to Plastics Department, Monsanto Chemicals Limited, Victoria Station House, London, S.W.1.

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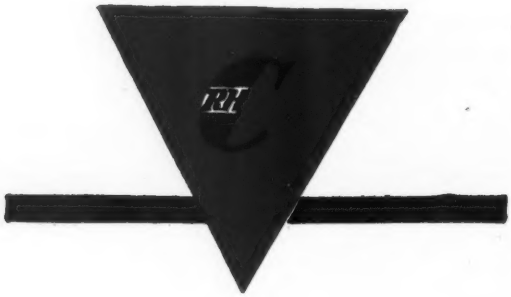

STYRON

Polystyrene Moulding Granules

manufactured by

DOW CHEMICAL OF CANADA LTD.

We are pleased to advise that customers' requirements can now be met in the full range of standard colours

●

R. H. COLE AND COMPANY LIMITED
2, CAXTON STREET, WESTMINSTER, S.W.1
Phone: Whitehall 0711/2/3 and 7193/4 Grams: Geratole, Phone, London

AN INTERESTING FEATURE ABOUT *CRYSTALATE*—

is the great variety of components in Plastics which they mould for widely different Industries as is illustrated by:—

RADIO CABINETS **RADIO KNOBS**

BATTERY TERMINALS **COSMETIC LIDS**

SWITCHGEAR HANDLES **DOMINOES**

VACUUM FLASK CUPS **IRON HANDLES**

LIPSTICK CASES **INSULATION BUSHES**

BRUSH HANDLES **TERMINAL BLOCKS**

VACUUM CLEANER PARTS

ELECTRICAL FITTING PARTS

TELEPHONE PARTS **etc. etc.**

All the above and a multitude of other parts are produced by the compression transfer and injection moulding processes in thermosetting and thermoplastic materials and Crystalate special materials.

CRYSTALATE

Crystalate Ltd., Golden Green, Tonbridge, Kent. *Phone: Hadlow 233/4/5 (20 lines)*

Established 48 years

Durastrip

1948 Novelties

(Regd. Designs)

Introducing a New Era for Ladies and Gentlemens' belts, sandals and other fashionable Novelties

Sole Manufacturers

DURATUBE and WIRE LTD.

FELTHAM . MIDDLESEX . ENGLAND

BLESS her heart, she calls it "Plastic!" and she's proud of it because it looks good and feels good. We're proud of it because it's made from Geon Paste Resin — one of the Geon Polyvinyl Materials. This resin gives hard-wearing coatings of matchless dry finish — and in a wide range of colours — from pastes produced by simple mixing with minimum plasticizer! Please write to us for full information on the properties, processing and supply of Geon Paste Resin — or any material in the Geon range.

Geon
Polyvinyl Materials

GEON 101	Polyvinyl chloride resin.
GEON 200 series	Vinyl copolymer resins.
GEON Compounds	Based on Geon resins.
GEON Latex 15X	Modified vinyl latex.
GEON Latex PX16	Plasticized vinyl latex.
GEON Latex 31X	Air-drying vinyl latex.
GEON Polyblend	Geon/Hycar blend.

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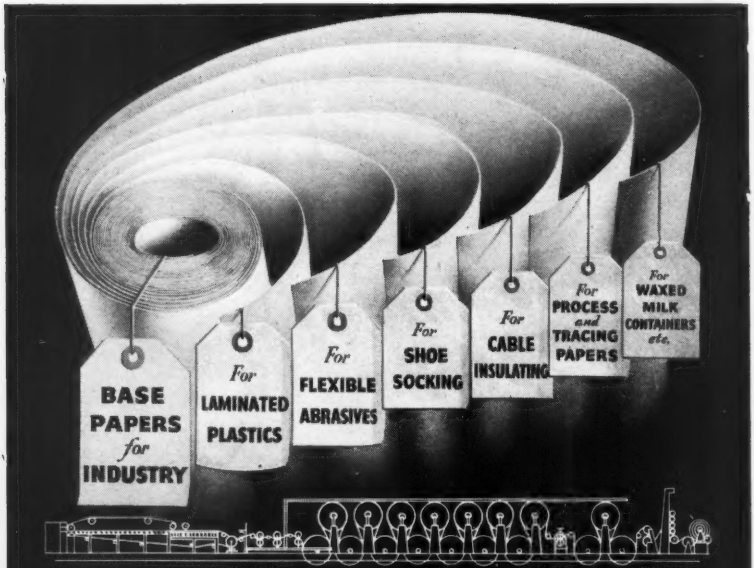

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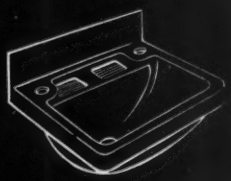

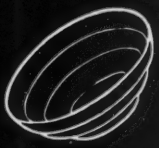

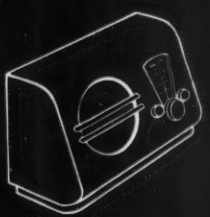

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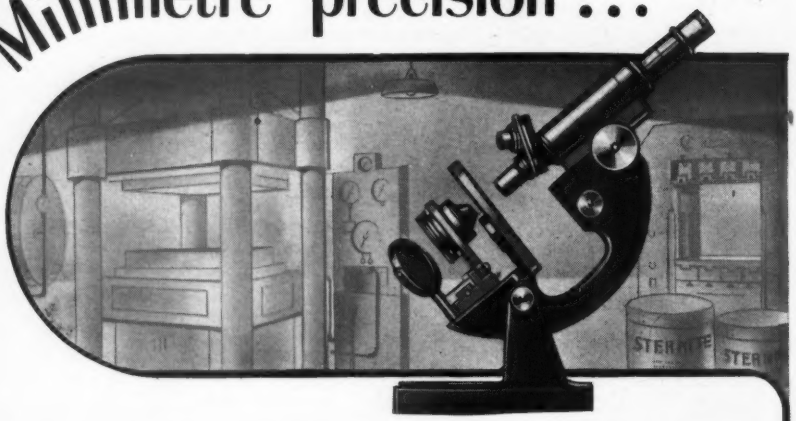

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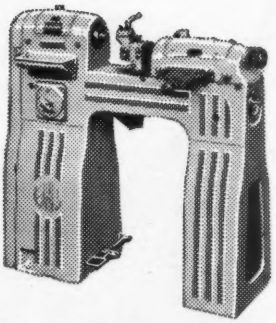

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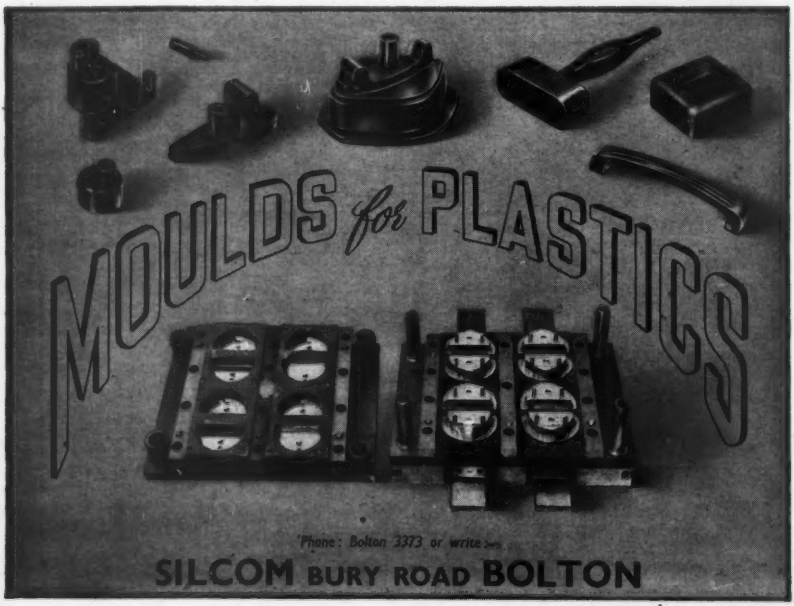

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Vol. XII. No. 135 AUGUST, 1948

Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Proprietors - - TEMPLE PRESS LIMITED
Chairman and Managing Director ROLAND E. DANGERFIELD

Editor - M. D. CURWEN, B.Sc., A.R.I.C.
Offices - Bowling Green Lane, London, E.C.1

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NOTICES

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EDITORIALS

The Bakelite Story

ABOUT the year 1924 we became outside and casual but interested observers of the activity of a concern known as the Damard Lacquer Co., Ltd., which well before the 1914-1918 war began the manufacture of phenol-formaldehyde resins in alcoholic solutions to replace shellac varnishes. It was in 1914 that Mr. H. V. Potter had joined the company as research chemist, and during 1917 not only solutions, but phenolic moulding powders and laminated sheets for insulation were produced.

In 1926 the second stage of development in the production of phenolic took place with the formation of Bakelite Ltd. by the fusion of Damard Lacquer and others, and a long co-operation with Dr. Baekeland's company began.

For more than 20 years, progress continued with an increasing knowledge of these now famous materials; new types of phenolic resins have appeared and their applications are seen in almost every sphere of industrial endeavour, in war and in peace, in variety that bewilders the general onlooker. This single field of plastic manufacture produces liquids for impregnation of paper, fabrics, wood, wood-veneers, and wood-waste, plaster and metal castings, for the electrical, furniture, aircraft and metallurgical industries, and the production of paints, varnishes and enamels. It produces moulding powders of a dozen or more varieties of mechanical strength and special physical and chemical properties for hundreds of different industries ranging from automobile construction to textile bobbins, from gearwheels and heavy engineering bearings to tiny toys, from tool handles to bottle caps.

The story of Bakelite Ltd. now takes another great step forward, for with the opening last month of the large new works at Aycliffe, in County Durham, we now see the new developments for this company of urea-formaldehyde resins, moulding powders and of polyvinyl chloride sheet and moulding materials.

Our pleasure at visiting these works did not only lie in the knowledge that they reflect the growing expansion of the whole of the moulding industry of this country, but that they will thus be able to meet the growing demands and to keep pace with other progress that is taking place in Great Britain, namely the growth of newer raw materials from petroleum and coal. Our pleasure was enhanced by the realization of the extraordinary modernity of the plant—indeed it must be the most advanced of its type in the world.

From the chemical plant, of which reaction vessels and the formaldehyde storage plant with its rubber-lined tanks and pumps are remarkable examples, to the completely automatic mixing, blending and grinding machines—all is joy to the chemist and chemical engineer.

On pages 409-415 of this issue we describe the proposed developments, some of which are still in the pilot and building stages. When the whole is complete and when the newer basic materials make their first flow through the plant, we shall have a still greater story to tell.

The new works must be a great satisfaction to that same Mr. H. V. Potter, who joined Damard Lacquer Co. 34 years ago and who has been the managing director of Bakelite Ltd. for a number of years.

To him and his co-directors we offer our sincere congratulations in the sure knowledge that they have raised the power of the British plastics industry to higher levels.

Americana

THE difficulties of international trade that are felt here are equally likely to spread in the United States, and future action has been discussed at the recent

meeting of the Society of the Plastics Industry at Atlantic City.

One speaker, Mr. T. Perutz, President of Omni Products Corporation, discussed the overseas market and foresaw a decrease in the foreign demand for American moulded goods. (This suggests that at the time of the meeting the decrease had not yet taken place. In this country we are only too aware of the contraction in demand.) He furthermore declared that the solution lies in the export of machines, moulding powders and other raw materials to those foreign areas where local demands and tastes would thus be better met. This may seem somewhat ingenuous, because the process of sending machines and raw materials from this country has been going on for nearly a century, in order that foreign manufacturers should be able to make the very things we were in the habit of exporting to them. However, Mr. Perutz also gave some very good advice in insisting that the best technical information be sent along with the machines and raw material and that the exact conditions of working in the foreign countries be first examined.

We are by no means sure that his solution is the only possible one. His ideas are probably slightly coloured, because of the fact that his company is confined to the export of plastic machinery and raw materials. We are convinced that both finished goods and machines can be exported to the same country. Given a reasonable chance of entry, we are convinced that the best quality and new ideas will always overcome restrictions.

An even more interesting discussion was opened by Mr. W. R. Dixon, of the Dow Chemical Co., who, while admitting that a lot of junk had been foisted on a long-suffering American public, insisted that more good plastics were made than poor. He declared that any programme of merchandising must promote the well-designed article made from the correct plastic for the specific use. He stated, furthermore, that the Dow Chemical Co. had set up a committee to evaluate the finished products made by the moulders of Dow plastics. This evaluation is carried out by a consideration of the intended use of the finished object, of the most suitable material for the job and of the proper design and fabrication. The moulding is then circulated amongst a consumer panel for final analysis.

U.S.A. Visitor's Views

At a recent meeting of the Women's Press Club, Mrs. G. Schreiber gave a talk on her recent visit to the U.S.A. Her notes have been forwarded to us through the courtesy of the Council of Industrial Design.

The speaker commented especially on one important feature of American life, namely, the willingness of the large stores to co-operate with industry. "You have no doubt heard," she said, "of the successful exhibition, '100 Useful Objects,' which Edgar Kaufmann organized at The Museum of Modern Art in January last. I was very impressed by the fact that a store like Macey's reserved one counter entirely for the display of the best design plastic tea-set which Kaufmann selected for his exhibition. If we could get our stores in Britain to follow this example, it would give those manufacturers who are not yet sufficiently design-conscious most valuable encouragement." This very subject is being taken up in this country by the Council of Industrial Design and we wish it every success.

On the subject of quality she says: "While certain consumer goods such as wireless and television sets, scales, vacuum cleaners and scientific instruments, etc., are produced in first-class quality, many household goods lack the solidity one has come to demand of an article for daily use. . . . Polystyrene is widely used for the production of kitchen strainers, trays, drinking vessels and labour-saving gadgets, which are well designed, practical and attractively coloured. They are, however, in my personal opinion, produced in too thin sections—the aim being to put on the market an article which is cheaper than the competitors, not better!

It is here that British goods have their chance."

We must protest against the implication that poor quality (thin, breakable sections) is a reflex of the "novelty and no wish to make things last for ever" cravings of the Americans. These cravings may exist but they do not arise when applied to kitchen utensils of the normal American housewife. If they did, what would be the value of sending good, solid stuff there? No, we believe the Americans want utensils that are not mechanically weak so that they may use them well for as long as they choose. Weak mouldings are products of poor moulds, of which the U.S.A. are not the sole possessors.

We are much more struck with Mrs. Schreiber's final remarks: "I noticed," she said, "during business discussions with both retailers and manufacturers over there, that again and again they were impressed with the reliable structure of British products, provided that they were also well designed and, of course, functional. So I came to the conclusion that it is no good trying to beat the Americans at their own game—trying to be similar to them . . . Being different from others should arouse the world's desire to buy our goods before others."

More About Cups

OUR recent remarks on plastic cups in general, on the importance of seizing the excellent opportunities now presented by the introduction of high-quality goods of the best design, may be augmented by a study of an American plastic cup, the general shape of which we have attempted to reproduce accurately as a drawing. The original illustration was published in an American journal.

The raw material used was polythene, obviously an excellent choice for the job, but if our interpretation of the shape is correct that would be the limit of our praise of this cup. It has obviously, we think, been designed for no other reasons than simplicity of mould design and mouldability on the one hand, and for ease of stacking on the other. These two objects have certainly been attained, but the results appear to us to be far from pleasing, and to have been reached at the expense of one basic characteristic.

We do not refer to the artistic merit or otherwise of the additional bulbous excretion which purports to serve instead of a handle. Rather must we stress our serious doubts that this handle can be efficiently held between first finger and thumb pressing between what seems a thickness of about an inch.

The mechanical "natural" act of lifting a cup, namely, first finger within the handle, thumb on top and middle finger at the back to act as a cantilever, has evolved the almost perfect conventional handle. The present form denies this natural action and, we believe, suffers accordingly. With 4 or 5 oz. of liquid within, support would seem impossible without great strain between the forefinger and thumb, and probably the little finger, incongruously, would have to be brought into play to hold up the bottom.

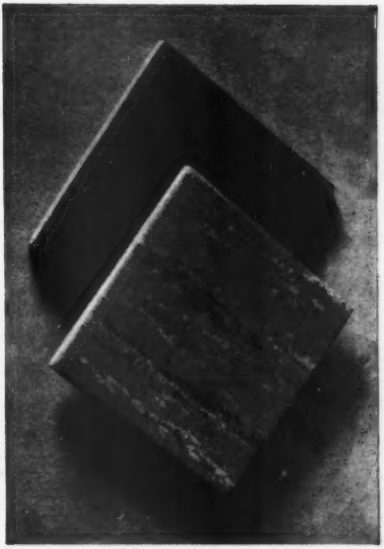
Surely there must be some solution between the non-stackable and the 100 per cent. stackable? We admit the importance of nesting for milk bar, ship's kitchen and teashop, and so on, but we do not believe that the conventional form of handle, or a close approach to it, can be entirely discarded. Otherwise the simple tooth-mug shape without handle would be the answer.

Resin-bound Floor Tile

A NEW decorative floor tile has just been introduced to the building trade. It comes under our notice in these pages because it is described as of "thermoplastic" nature, being made from a synthetic resin binder, fibrous mineral fillers (asbestos), and non-fading pigments. The ingredients are uniformly amalgamated, and then calendered under high pressure into sheets of uniform thickness. Finally, the sheets are cut into tiles of precise dimensions and with clean, square-cut edges. A range of plain and marbled shades is in production, and allows scope for the creation of distinctive designs and colour harmonies. Sentex, Ltd., of 185-9, Finchley Road, London, N.W.3, a Dunlop company, are the makers.

We have examined samples of these "Semastic" tiles and have been impressed by their excellent quality. According to the report of some investigations carried out at the Building Research Station at Watford, they are likely to show very good resistance to wear under moderately heavy conditions of foot traffic, as in houses and offices. Moreover, they are very little affected by damp conditions, as a consequence of which it is not essential to employ a damp-proof membrane in the base concrete when such tiles are laid on a site liable to become damp. As to general qualities, the tiles are non-slipping, warm to the feet and fairly quiet. They do not readily become stained, are easily cleaned and fairly hard under tread, although they may dent under prolonged loading, as with heavy furniture. The standard size is 9 ins. by 9 ins., thickness $\frac{3}{16}$ in.

A test floor laid down at the Building Research Station is reported to have been in use for seven months, during which time 173,000 people walked over it without impairing its appearance and with no sign of any of the tiles being loosened. The only maintenance which this floor



received was regular brushing and occasional washing. Surface scratches are claimed to "heal" under continued foot traffic. The consolidation of the tiles under high pressure ensures the maximum degree of resistance to wear.

Hardness, determined by measuring the impression produced momentarily by a 1-in. steel ball when allowed to fall from a height of 6 ft., compares with that of conventional flooring materials:—

Type of floor.	Impression (mm.).
Linoleum	12.2–8.6
Sheet rubber	11.9
Normal cork tile	9.0
Wood blocks	8.9
"Semastic" tile	6.1
Quarry tile	4.0
Magnesite composition	3.5–6.8

Although reasonably resistant to staining, the tiles should not be used in situations where oil or alkali is present.

The U.S. Society of the Plastics Industry Inc. is to hold its third National Plastics Exposition in the Grand Central Palace, New York from September 27 to October 1, both dates inclusive. The latest developments in plastics machinery will be shown.

High-frequency Welding of Cellulose Acetate Sheet

By H. P. Zade* and V. Stannett†

CELLULOSIC plastics, and particularly those based on cellulose acetate, are finding an ever-increasing field of application and are used for the manufacture of articles of all descriptions. A very large proportion of these are made in particular by the injection-moulding process, but, in addition, their fabrication from sheet material is of considerable importance. For instance, cellulose acetate sheet or film which is made either by the slicing, extrusion or film-casting process is used in considerable quantities for the manufacture of transparent boxes and containers, whilst embossed film is one of the most popular and useful materials for the manufacture of lampshades.

Up to quite recently the most common method of fabrication involved cementing the sheeting by means of acetone or other solvents, or by cellulose acetate dopes. This method, although yielding a strong joint, suffers from a number of inherent disadvantages. The process is slow and it is extremely difficult to get a strong and blemish-free joint even with skilled operators, especially when, as is nearly always the case, a fast rate of production is to be maintained. Another disadvantage should be mentioned, namely, that the evaporation of the solvent from the joint is often accompanied by crinkling and buckling, an effect which is due, presumably, to differential shrinking. It is virtually impossible to obviate this latter difficulty entirely.

The progress which has been made over the past few years with the welding of thermoplastics induced the authors to investigate the possibilities of "heat sealing," or "welding," of cellulose acetate film. As the film thicknesses usually employed are fairly substantial, the use of heated tools was not considered advisable, since the slow heat transfer through the sheeting would lead to overheating of the surfaces prior to obtaining a bond between two sheets. The obvious solution was thought to be high-frequency welding, a process in which the outer surfaces of the sheets could be kept at a low temperature through contact with the cold metal electrodes while heat is generated substantially through the whole thickness of the sheets; at the same time mechanical pressure is applied to the electrodes.

A large number of experiments were carried out with various types of commercially available cellulose acetate sheeting. The results were not very satisfactory. It was found that the ordinary type of rigid cellulose acetate sheet, in thicknesses between .010 in. and .025 in., requires the application of fairly high voltages for welding, a fact which in most of the experiments led to an electric breakdown of the material prior to welding. In addition an embrittlement occurred at either side of the weld. The experiments were carried out with a standard-type high frequency welding machine, using an operating frequency of 30 Mc/s.

If the frequency was increased in order to reduce this danger it was still found that owing to high viscosity the flow of the material in the heated state was unsatisfactory, and that considerable pressure was required to obtain a bond. Even in these circumstances the bond usually was of a superficial nature only—i.e., it was found that on cooling it was

* Rediffusion Ltd.
† Utilex Ltd.

still possible to separate the sheets with comparative ease.

It soon became clear that little hope could be held out for the commercial application of high-frequency welding unless the cellulose acetate itself was modified, or possibly the electronic characteristics of the welding equipment were improved. Recent reports from the U.S.A.[1] indicate that promising results have been obtained for the high-frequency welding of ordinary types of cellulose acetate, but it should be pointed out that a very high frequency (200 Mc/s) was employed for these tests, a fact which clearly introduces additional complications in the design of the welding machines.

New Types of Acetate Sheet with Improved Welding Properties

The main objectives in modifying the cellulose acetate sheeting were to lower the softening point to a workable range, to raise the electrical breakdown voltage, and to incorporate plasticizers of extremely low volatility and with good flame-retarding properties. The embrittlement of the film at either side of the weld was thought to be due either to degradation of the cellulose acetate or to loss of plasticizer,

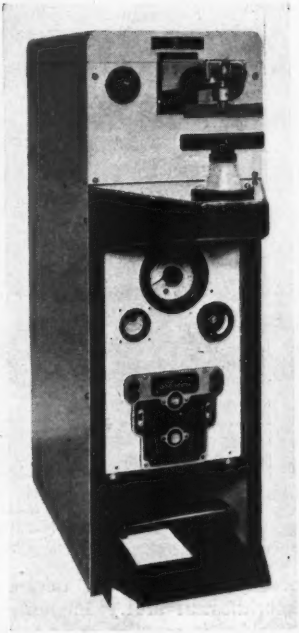


Fig. 1.—High-frequency jig welder, output 350 watts. (Courtesy, Rediffusion Ltd.)

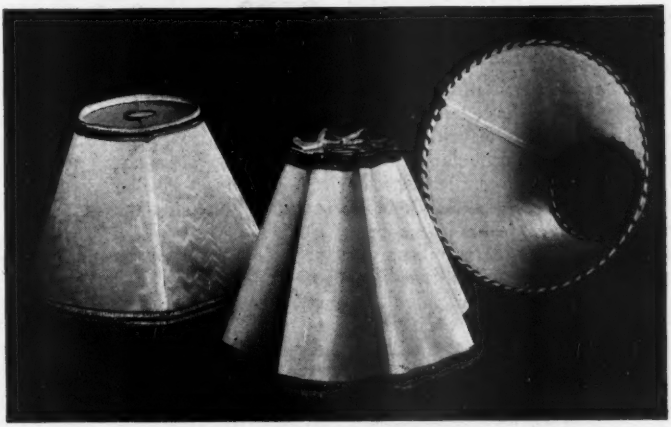


Fig. 2.—Welded cellulose acetate lampshades. Material supplied by Utilex Ltd. (Courtesy, Rediffusion Ltd.)

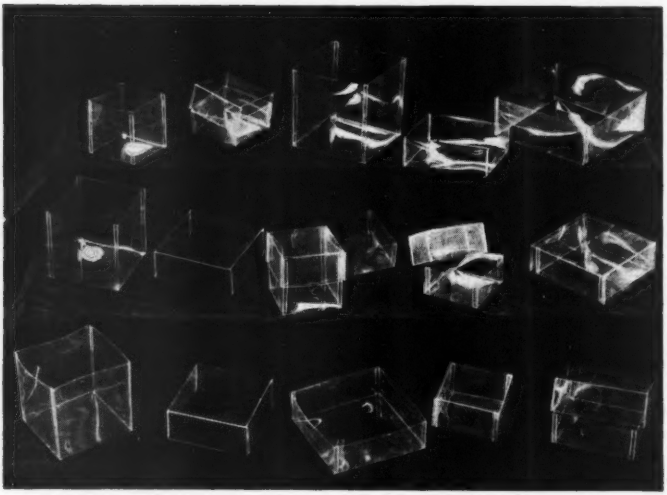


Fig. 3.—Welded cellulose acetate boxes. Material supplied by Utilex, Ltd. (Courtesy, Rediffusion Ltd.)

enhanced by the change of thickness in the embrittlement area. In either case considerable improvements would be obtained by a general lowering of the softening point.

The cellulose acetate sheeting could obviously be modified in two main ways: (1) By changing the grade of cellulose acetate, i.e., with respect to acetyl content and viscosity; or (2) by changing the nature and proportions of plasticizers used. The stability of the cellulose acetate used would also affect the brittleness of the weld, but as highly heat-stable grades of acetate are now customarily used for the manufacture of commercial film, it was considered impracticable to concentrate on this aspect of the problem.

Various grades of cellulose acetate were used to make up films containing the same type and proportion of plasticizers. It was found that although the welding quality did vary with acetyl content, etc., the changes brought about were not in general of practical significance in preparing a film which was readily weldable. Further experiments were then carried out, changing the nature and proportion of the plasticizers. Here more success was achieved: it was found that films containing a certain proportion of plasticizers correctly balanced with respect to volatility and flame-retarding properties could be welded by high frequency with comparative ease and speed. Furthermore, the possibility of producing these special grades of high-frequency weldable cellulose acetate films by normal film-casting technique was established. In addition to clear transparent qualities, a wide range of opaque and translucent colours were also made without substantially affecting the weldability of the film.

Since these experiments were carried out it has been found that a number of commercial films can also be welded by high frequency with, however, varying degrees of ease. In general, low plasticizer content film and sheet is difficult to weld under any circumstances, and the prevalence of this type of material, particularly among cast commercial films, no doubt helps to explain the lag in adopting

high-frequency technique for the welding of cellulose acetate sheeting in general.

Innumerable articles can be manufactured from cellulose acetate by welding, but only a few will be mentioned in the course of this article.

Fig. 1 illustrates the type of high-frequency welding machine which was used for the experiments: it is a commercial type of welder, and is particularly suitable for the welding of articles such as lampshades and boxes, on account of the free-standing lower electrode, which permits access in all directions. For the welding of lampshades the electrodes are usually fixed in a position at right angles to that shown in the illustration; this enables the operator to feed the truncated-cone-shaped lampshade over the moving arm prior to welding. In the case of very large lampshades it is even possible to wrap the unwelded shade over the anvil-shaped holder of the fixed bottom electrode. In both cases the weld line is facing the operator, and alignment of the overlapping edges is, therefore, made easy.

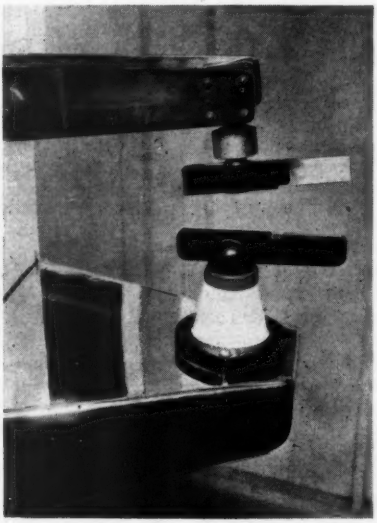


Fig. 4.—Swan-neck electrodes as used for box welding. (Courtesy, Rediffusion Ltd.)

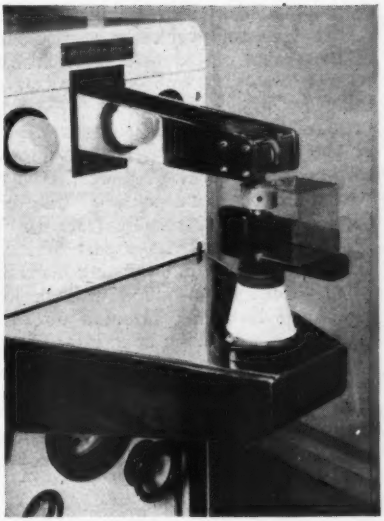


Fig. 5.—High-frequency welding of cellulose acetate box. (Courtesy, Rediffusion Ltd.)

Fig. 2 shows a number of lampshades made from surface-embossed and pigmented cellulose acetate sheeting. The welding seams are faintly visible. Welding times are of the order of 2 to 3 secs., depending on the length of the seam. It is obvious that high-frequency welding lends itself very well to the mass-production of plastic lampshades.

The use of clear transparent cellulose acetate sheet for the manufacture of boxes of various shapes and sizes is well known to a large number of trades who use such boxes for display and packaging purposes. Perfumes, sweets, fancy goods and other merchandise can be displayed in containers of attractive appearance made from transparent sheeting. Fig. 3 shows a variety of such boxes, with and without lids, which have been fabricated by welding of the overlapping corners. The clean and uniform appearance of the welding seams is difficult to illustrate in a photograph, but is very striking in the actual article.

The welding of boxes, particularly

those of comparatively small sizes, presented a special problem with reference to the design of the welding electrodes. It was obviously impossible to utilize ordinary straight electrodes (Fig. 1), because their method of suspension prevented access to the weld area in the corners of the boxes. A special type of "swan-neck" electrode was therefore developed for this purpose (Fig. 4). It will be seen that a large part of these electrodes consists of insulating material, whilst the exposed metallic surfaces project sufficiently to permit insertion into the box corners. It has to be mentioned that the length of the metal parts of the electrodes should be equal to the depth of the box, and that all sharp edges should be radiused carefully to avoid field concentrations and danger of electrical breakdown at these points.

Fig. 5 shows the welding of a box corner seam with the electrodes closed for the welding operation. Multiple electrodes have also been designed for the simultaneous welding of two corners of a box; in this case automatic location of the prefolded box blank has been ensured by appropriate shaping of the bottom electrode.

The applications mentioned here obviously cover only a small section of the various industries using cellulose acetate for fabricating purposes.

In view of the fact that very little information has been made available on high-frequency welding as a manufacturing process for cellulose acetate, we have endeavoured to give a short résumé of our work in this connection, and have tried to show some of the reasons why this new process has up to now not yet met with the whole-hearted approval of manufacturers which it certainly deserves.

(1) Electronic Box Stayer, "Mod. Packaging," 1948/Feb./113.

NEW LABORATORIES FOR B.I.P.

New laboratories for the research staff of British Industrial Plastics, Ltd., were formally opened by Mr. Kenneth Chance, chairman and managing director of the B.I.P. Group, on June 2. These laboratories are at Tat Bank Road, Oldbury, where a two-storey building now houses the entire B.I.P. research staff.

Separate laboratories are provided for research in the fields of paper resins, lacquer and coating resins; of textile resins and bonding resins; and, in addition, there are a physics laboratory, general research laboratory, and engineering development, and industrial development departments. There are also facilities for testing "Beetle" moulding powders and "Beetle" cements under actual working conditions. Two buildings adjacent to the main laboratories contain a moulding shop and miniature plywood factory for this purpose, and also pilot scale replicas of B.I.P. production plant for producing experimental quantities of material.

The B.I.P. research staff was formerly housed in the nearby B.I.P. office buildings at Popes Lane, opened in 1920. It was there that the first commercially successful white moulding powder was produced in 1926.

PLASTICS NEWS FROM CANADA

Plastic fabricators in Canada have informed the Radio Manufacturers' Association that Canada has sufficient capacity to meet the domestic market demand for radio cabinets. Last year Canada imported an estimated 170,000 plastic radio cabinets, with a value of $130,000; at the same time the domestic industry turned out about 400,000 cabinets. The radio industry in Canada looks like becoming a still more important field for the attention of the plastics industry, because an ordinary radio contains about 200 plastic parts, most if not all of which can be made in Canada.

The Arborite Co., a subsidiary of Howard Smith Paper Mills, Ltd., is erecting a new plant at Ville LaSalle, near Montreal, to produce laminated plastic wallboards, table tops and electric panels, items which are already manufactured at the company's plant at Cornwall, Ontario. The main product of the Arborite Co. is a plastic laminate developed, in Canada, during the war in conjunction with the Department of Munitions and Supply. Research chemists of Howard Smith Paper Mills developed "arborite" plastic as a result of their experiments with lignin, the natural resin cement binding wood fibres.

World's Industry Employs Plastics

GENERAL ENGINEERING

Reinforced joints.—A table of characteristics and configurations of reinforced plastic joints has been compiled by R. Francis (" Product Engineering," 1948/May/104). It is stated that long fibred reinforcements in thermosetting polyester, phenolic, melamine and silicone resins provide strengths into the steel range.

Elasticity of plywood.—H. Brunner calculates the elastic behaviour of plywood in tension and shear when the angle between the fibre directions is arbitrary, i.e., not always 90 degrees. (" Schweizer Archiv fur angew. Wissenschaft & Technik," 1948/May/138.)

Rubber-metal bondings using galvanic deposition of brass are described by G. E. Prooke. (" Metall Oberflaeche," 1948/2/79.)

CHEMICAL

High polymers.—The pyrolysis or thermal decomposition procedure has been applied for the analysis of high polymers such as polystyrene, neoprene, rubber, nylon, etc., thus separating the material into gaseous, liquid and semi-liquid fractions. (" Technical News Bulletin," Nat. Bur. Standard, 1948/32/25.) In these tests plastics are exposed to controlled conditions of heat humidity, ultra-violet radiation and ambient atmospheres. The gaseous degradation products are collected and analysed with the mass-spectrometer. Changes in structure are determined by ultra-violet absorption, infra-red absorption, X-ray diffraction, electron microscopic and dielectric absorption characteristics. (Abstract in " Production Engineering," 1948/May/132.)

New synthetic rubber announced by the U.S. Rubber Co. is made at the low temperatures of between zero and 40 degrees F., instead of the customary 125 degrees F. (" Mechanical Engineering," 1948/Mar./244.)

Polyacrylic ester.—Hycar P.A. (B. F. Goodrich Chemical Co., Cleveland, Ohio) resembles natural pale crepe rubber. When vulcanized it has outstanding resistance to heat, oils, ultra-violet light, ozone and gas diffusion. It is capable of being compounded and vulcanized in a wide range of soft to hard compositions. (" Scientific American," 1948/Apr./181.)

MISCELLANEOUS

Wire-braid flexible tubing, " Ronaflex," is said to have its life greatly extended through buna- and neoprene-base synthetics. A tubing of ¼-in. internal diameter will withstand bursting pressures up to 1,000 lb./sq. in.; up to 2 in. diameter proportionately less. (" Products Finishing," 1948/May/118.)

Cellulose plastics are surveyed in an illustrated article by M. Bentivoglio and M. Demares. Cellulose nitrate and acetate, cellulose acetate-butyrate, cellulose propionate and ethyl cellulose are included. The mechanical, thermal and electrical properties of these materials are given in the form of tables and graphs. (" Product Engineering," 1948/May/85.)

Polythene insulation.—A. S. Windeler describes the development and construction of the Video-Pair cable used in television pick-up installations. This is a shielded balanced cable pair insulated with polythene and air. (" Bell Laboratories Record," 1948/26/201.)

Carpet material, " Splendante " (Nye-Wait Co., Auburn, N.Y.), has a pile completely woven with Du Pont nylon. It can be cleaned with soap and water and is non-inflammable, and although the pile will melt under fire, it does not support the flame. The material can be stored, if clean, without any special protection against damage by moths. (" Business Week," 1948/May 29/70.)

Rubber propeller for outboard motors, encasing a metal core of cast aluminium or bronze, has been announced by Goodyear Tyre and Rubber Co. The metal core provides sufficient stiffness to cut the water, while the rubber covering lends resiliency for sliding over weeds without fouling, or bouncing over driftwood and other obstacles without shearing the drive shaft pin. Development of this propeller was made possible through recent research on rubber-to-metal bonding, using die castings of light metals in conjunction with adhered rubber.

Nylon-reinforced V-belt, said to have twice the strength and four times the average life of conventional V-belts, has been developed by the United States Rubber Co. The belt contains a series of tough nylon cords covered with synthetic rubber compound capable of withstanding the deteriorating effects of heat and oil. The belt is particularly recommended for power transmission on equipment subject to rough usage, such as grain harvesting, oil wells and paper-processing machinery. In addition to high tensile strength, it has great flexibility, and a sufficient amount of elasticity to absorb shock.

P.V.C.-Plasticizer mixtures.—W. Birnthaler discusses the volume effect which occurs when mixing polyvinyl chloride with plasticizer. The integral volume effects are negative for plasticizer concentrations from zero to 60 degrees. The author assumes that for higher concentrations no volume effects may occur. (" Kunststoffe," 1948/Jan./11.)

Rubber curing.—For the continuous curing of components of exceptional length, rubber mixtures which cure rapidly are required. P. Nowak reports on such experiments and shows that butadiene styrol mixed polymers are in particular suitable for this purpose. (" Kunststoffe," 1948/Feb./33.)

Radar equipment.—A new tower head for an antenna-pattern plotter contains more than 25 precision machined plastic parts of cast modified polystyrene, having high electrical qualities. (" Products Engineering," 1948/Apr./163.)

Dental applications.—W. Bauer surveys the application of plastics in dentistry, and further deals with the production and properties of the materials used. Polymethyl methacrylate does not appear to meet all demands, possibly due to inadequate knowledge of the polymerization methods. (" Kunststoffe," 1948/Jan./1.)

SOURCES OF REFERENCE

We wish to remind readers that the sources of reference from which these pages are compiled are not, in general, retained in this office. We cannot, therefore, undertake to supply such originals. Nevertheless, most of the foreign journals referred to are available in the Patent Office Library (Southampton Buildings, Chancery Lane, W.C.2) and in the Science Library (South Kensington). Photo-duplicated copies of articles may be obtained from the Photostat Dept. of the Patent Office.

Exterior view of mobile bank by Coventry Steel Caravans, Ltd., of Warwick, showing use of "Perspex" for natural lighting through the roof, windows, and window peaks. This is a typical example of the mobile offices which are being ordered by the principal British banks.

Interior of the private office in mobile bank by Coventry Steel Caravans, Ltd., of Warwick, showing detail of "Perspex" window and roof lighting.

(Courtesy, Coventry Steel Caravans, Ltd., and I.C.I. Plastics Division.)

BOOK REVIEWS

SPI Handbook. Published by the Society of the Plastics Industry, 295 Madison Avenue, New York, U.S.A. Pp. 451. $4.50 (members); $7.50 (non-members.)

It is difficult to over-praise this book, for within these 451 pages there is not only a wealth of information for the plastics moulding and fabricating industry, but it has been so excellently collated as to be invaluable to the United States as a nation. By this we mean that it is invaluable to the engineer, chemist and physicist outside the plastics industry, and to the Government departments, who must have before them all relevant data as to the mechanical and physical strengths and performance of plastics under varied conditions.

Equally, a similar book (suitably revised with especial regard to the appropriate British Standards Specification) is an urgency in this country. We are labouring here under extraordinary shortages of paper and finances, but we believe it should be a first call on the efforts of the Plastics Institute or the British Plastics Federation, or both.

SPI Handbook amply reflects the status of an American industry that has risen in production from 220 million pounds to 1,500 million pounds in 10 years, and it has been compiled with a praiseworthy collaboration of some 300 very capable technicians. Among these we note the name of Mr. A. J. Warner, who has worked in the U.S.A. for some years and is now back in this country.

Of special value, in the sense we indicate above, is the opening chapter on "Classification of Plastic Moulding Materials," which has been compiled to promote the intelligent use of plastics. A large classification table includes values of mechanical, electrical, optical, thermal, chemical and ageing properties of the rigid type of plastics, and, in addition, a carefully correlated list of the standard testing methods laid down by the American Society for Testing Materials, the National Bureau of Standards, and the Joint-Army-Navy Plastics Specifications.

The remaining chapters cover moulding and forming plastics parts; design of moulded articles; design standards for inserts, their application in plastics parts; standards for tolerances on moulded plastics parts; cementing and assembly of plastics; testing plastics parts; mould design and recommended steels; machining and finishing plastics parts; and laminated products and their fabrication. Each is exceptionally complete and often contains good information on processes which hitherto have scarcely been mentioned in the literature.

Obviously British methods sometimes differ from those portrayed, but we do not think anybody can quarrel with the general basic principles laid down, such as, for example, in designing moulded articles and the design of the moulds themselves. Both sections are especially worth reading, and we like the occasional inclusion of aphorisms such as that in the chapter on mould design: "We can mould an article only as good as the mould."

We offer our very sincere congratulations to the Society of the Plastics Industry for this very courageous and timely production.

Advanced Industrial First Aid. By R. A. Trevethick. Pp. 63. Henry Garnett and Co., Rotherham; 3s.

The author of this small book is resident medical officer at the Peech and Tozer branch of the United Steel Companies, Ltd. The matter was, in the first place, specially written for the use of the various first-aid teams throughout the company's works, but in view of the many requests received from outside bodies it was decided to have it republished. Shock, wounds, burns and scalds, hæmorrhage, fractures, dislocations, sprains and strains are all dealt with in turn, and signs and symptoms, and the necessary treatment in each case, appear to be set out in a very lucid manner.

New Works of Bakelite, Ltd.

ON Tuesday, July 20, we went to Aycliffe, in the county of Durham, to see the opening of the new works of Bakelite, Ltd., and to note the first stages of a remarkable development that will cost well over £2,000,000 and eventually cover 75 acres.

At three o'clock on that day, Mr. Harold Wilson, President of the Board of Trade, in the presence of the technical Press of the country, pressed a master control push-button and started the new phenolic material unit and the pilot plant for the manufacture of urea moulding material. Production of Vybak (p.v.c.) compounds for electric cable covers and as flexible and rigid sheet also started.

Each of these sections is completely unique in its structural and modern conception for there is none like them in the world; the whole portrays a breadth of outlook of exceptional promise to the future of our industry and a salutory answer to those who believe that industrial adventure is at an end in this country.

These sections are in three main blocks which dominate the existing site. Designed by Mr. J. Wilson Hays, F.R.I.B.A., they provide a fit setting for the elaborate plant they already contain, the whole of which has been designed by the engineers of Bakelite, Ltd., and built in Britain.

Opening of this new unit brings into production the first fully automatic closed-circuit moulding material manufacturing plant ever built. It will make an appreciable difference to the total output of Bakelite moulding material and an effective contribution to the needs of the electrical and engineering industries.

Phenolic Moulding Material Unit

The technical layout of the phenolic unit may be considered in three stages:

(a) Raw materials section.

(b) Rolls section.

(c) Grinding and finished product section.

The major raw materials are powdered Bakelite resin and wood flour. There are also the critical additions of dyes, pigments, plasticizers, hardening agents, etc., which are collectively termed "master batch." There are thus three feed inlets for these raw materials, plus a fourth main hopper into which is automatically fed moulding material returned by the dust extraction plant.

Materials from these four primary hoppers are carried by enclosed conveyors and elevators to the top of the building, where they are discharged into

individual hoppers. Each raw material feeds through its own automatic weighing machine, the resin, master batch and recovered material passing into a common hopper on the floor below. From here this mixture is carried up again to a disintegrator, and, after grinding, descends once more to the floor below to another hopper, into which the wood flour also is fed.

All the ingredients for the moulding powder have now been brought together and are ready for the first of the thorough mixing and kneading processes to which they are ultimately subjected. They are, therefore, lifted once more by an elevating system to the top of the building to feed into a "continuous" blender, which is a giant rotating drum where the initial thorough mixing takes place. The final operation in this raw materials section is the feeding of the mix by gravity into a huge storage chamber below.

Kneading and Masticating

The object of the hot rolling process which forms the second stage of manufacture is thoroughly to knead and masticate the material. Horizontal conveyors carry the mix from the storage chamber to the first set of hot rolls. Here the material undergoes a complete change, entering the rolls as a powder and leaving as a steaming rubbery sheet. The length of time spent on the rolls is critical and is automatically controlled by electrically operated timing circuits. The charge leaves the first set of rolls and passes by conveyor to a second set, even more massive in size, where the kneading process is completed.

The rubbery sheet rapidly cools to a brittle solid, and is fed from the rolls to crushers and grinders at the next stage of the production sequence. The pulverized material is then lifted for the last time to the very top of the building and to its final production stage.

The crushed material discharges into an automatic sifter, the object of which is to screen it to the required mesh. Material which fails to pass the sieve is returned for further grinding. The powder passing through the sieve falls onto a conveyor which feeds it to the finished product blenders—two huge rotating drums where the final mixing and blending take place which are necessary to ensure uniform moulding qualities. From the blenders, the powder feeds by gravity through an automatic weighing mechanism, then over magnetic separators to remove any ferrous matter, and finally into drums ready for dispatch.

Testing

Testing is carried out at each stage of manufacture, and an elaborate pneumatic tube system has been adopted for the dispatch of samples to the Physical Test Laboratory. Each raw material employed is tested before reaching the unit at all, and specimens are subsequently taken at the initial blending, from the hot rolls, from the finished product blenders, and from the drums themselves.

The tube system enables the samples to reach the Physical Test Laboratory within a few seconds of their being taken. Reports on the material are returned by the same means.

Control

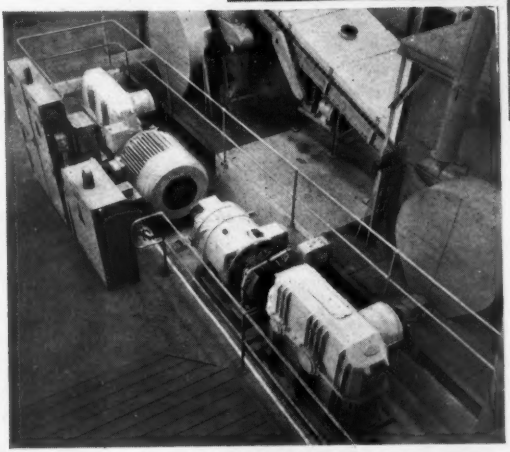
Control of all operations is fully automatic, complex electrical circuits being responsible for timing, opening and closing valves, starting and stopping rolls, and so on.

Thermostatic temperature controls govern all the heat processing aspects of the production sequences, and provide also a graphical record of the temperature conditions to which each batch of material has been subjected.

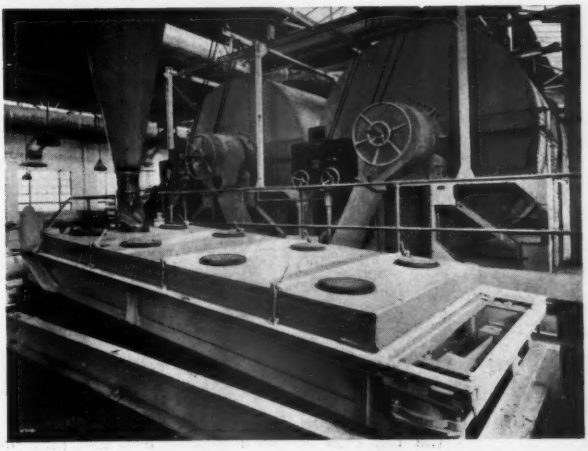
Urea Moulding Material Unit

This is housed in one of the three large new blocks and is devoted to the production of urea moulding materials. The process is similar in principle to phenolic moulding material production in that there is a mixing, hot rolling, pulverising, sifting, separating and drum-filling sequence. There are, however, many differences in practice, the outstanding difference in this unit being that the cycle

(Right) Phenolic Unit. General view of the conveyor system for the continuous production of phenolic moulding material. In the foreground, to the right, are seen the hot rolls.



(Left) Phenolic Unit. Hot rolling is conducted on two sets of rolls which are individually driven by 120 h.p. and 150 h.p. motors. A conveyor feeds the powder from one set of rolls to the other.



(Right) Phenolic Unit. Close-up view of the automatic sifting mechanism, with giant rotating drums for finished product blending in the background.

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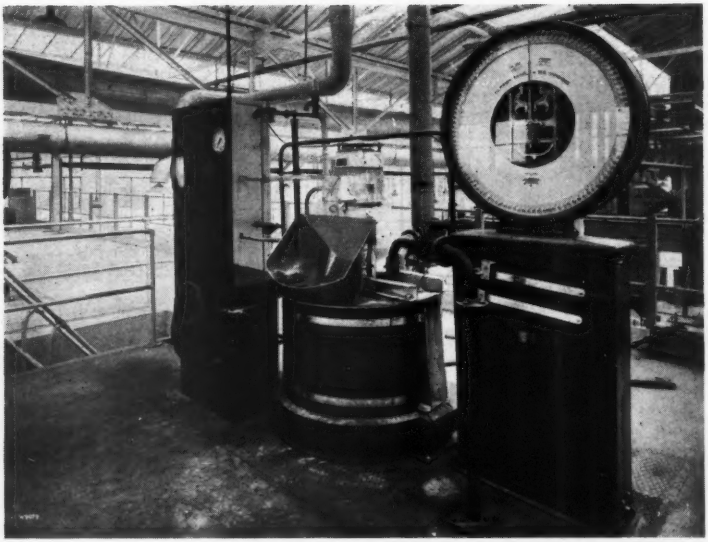
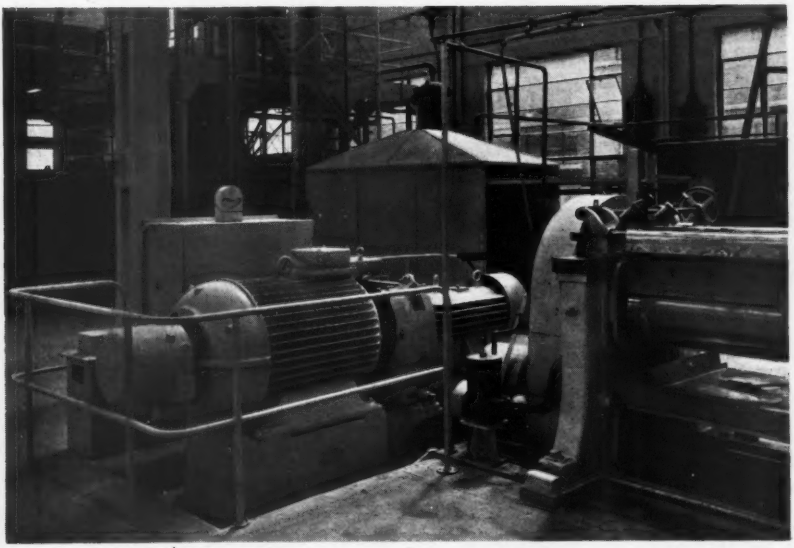
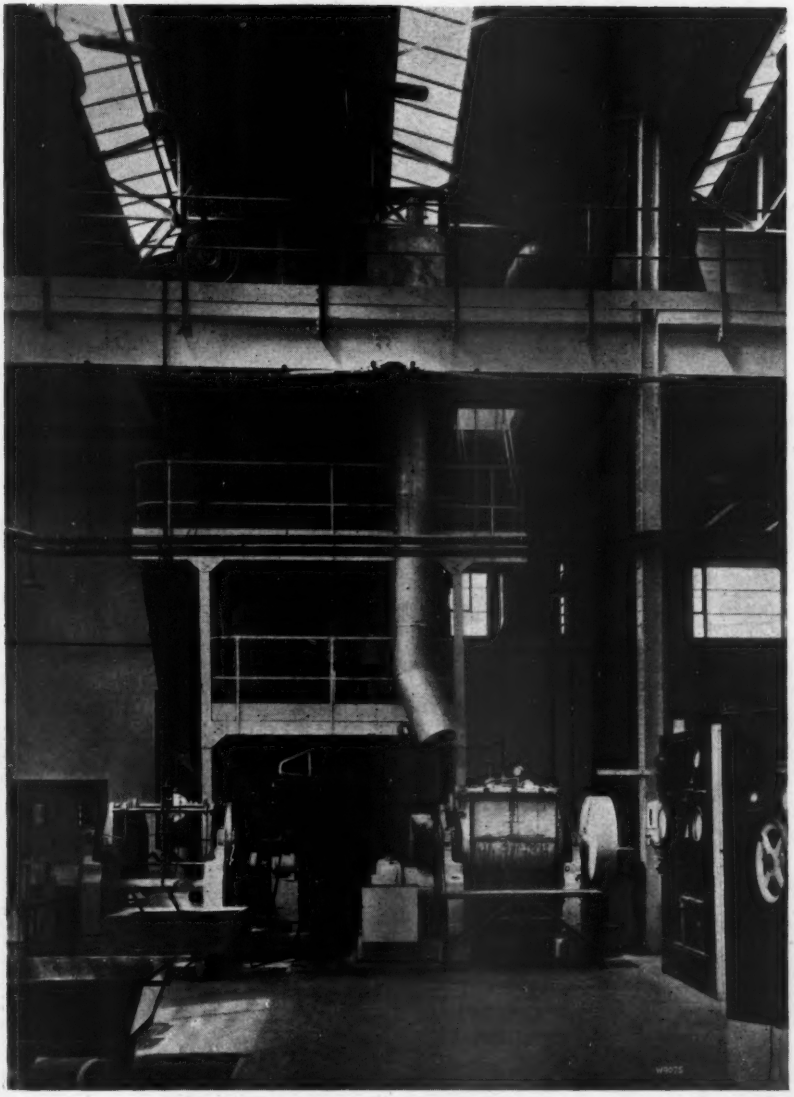


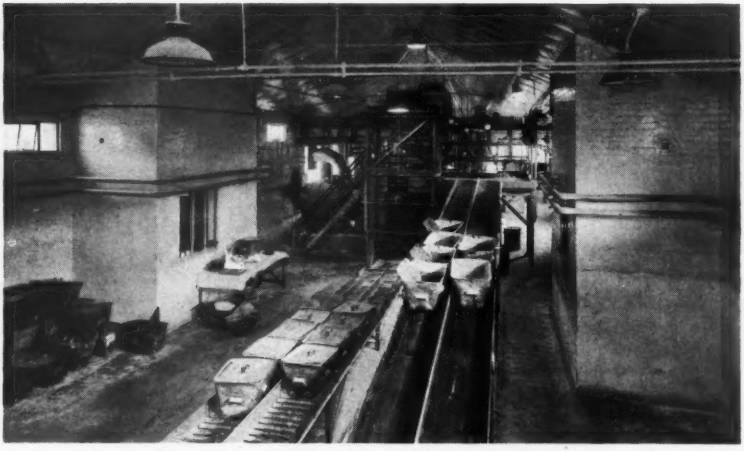
Urea Unit. The first stage in the manufacture of urea moulding powder is the feeding of the raw materials for urea resin into a combination weighing machine and reaction vessel.



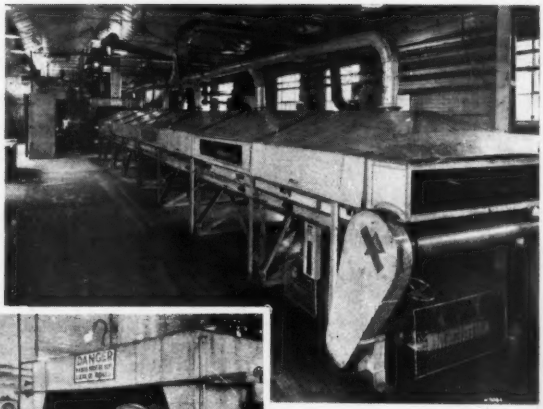
Urea Unit. An individual drive, from a 75 h.p. electric motor, is provided for the hot rolls in the manufacture of urea moulding powder.



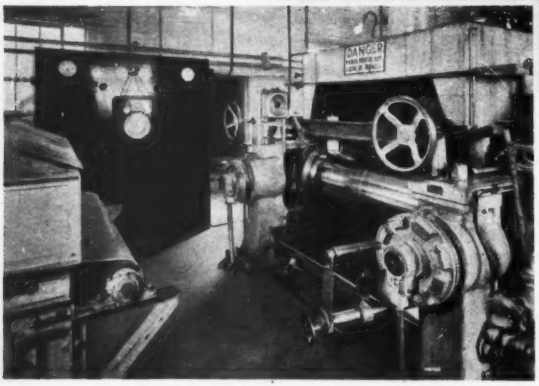
General view of Urea Unit. Raw materials for resin manufacture are fed to the plant at the top of the building. The liquid resin then runs into the cooling vessel immediately below. Cellulose pulp, plasticizers, etc., are finally incorporated with the resin in the heated vacuum mixer ,seen adjacent to the control panel.



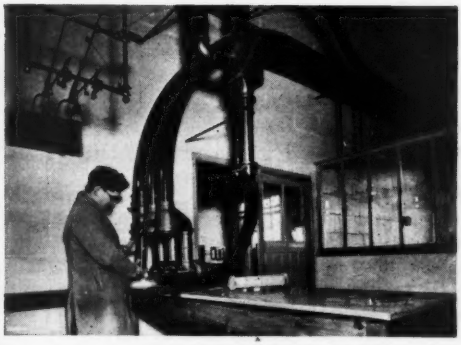
P.V.C. Unit. A roller conveyor system takes the bins of ingredients from the mixers to an elevator (centre background), and from there another conveyor feeds a Banbury mixer.



(Right) P.V.C. Unit. On leaving the hot rolls, seen in the extreme background, the Vybak material passes through a cooling conveyor on its way to the final crushing process.

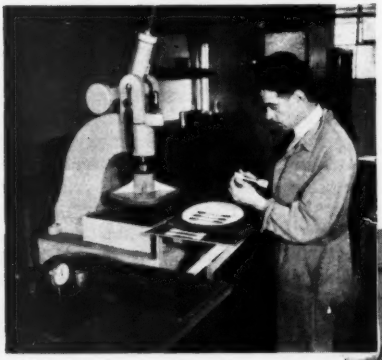


(Left) P.V.C. Unit. View of part of the hot rolls. Hot rolling ensures a thorough kneading and mastication of the materials used.



Samples of all materials at various stages of manufacture are passed to the Physical Test Department by a pneumatic tube system.

(Below) For determining the cold bending properties of Vybak plastics, the specimen is wound on a standard mandrel immersed in a freezing chamber.



(Left) Specimens for tensile strength tests on Vybak material are cut from a sheet of standard thickness.

(Above) The "cup flow" test on thermosetting resins is carried out in accordance with B.S.771.

(Left) Measurement of the cross breaking strength of a standard moulded section is routine for urea and phenolic moulding powders.

includes the manufacture of the urea resin itself.

Our starting point here is at the top of the building, where raw materials are taken by elevator to feed into a machine which combines the functions of weighing machine, mixer and reaction vessel. Urea and formaldehyde are the raw materials. When they are brought together there is a rapid drop in temperature which is compensated for by heating the chamber to bring the mixture again up to room temperature. At this stage the catalyst is added, the temperature is raised and the reaction begins.

The urea resin is run off from the reaction vessel to a cooling vessel below, where the temperature is lowered to halt the reaction. In feeding to this cooling vessel, the resin passes through a sight tube so that watch may be kept for any impurities. One of the results of this reaction, for example, is the formation of scum on the surface of the liquid resin. This scum is by-passed to waste and the reaction vessel thoroughly cleaned out ready for the next charge.

Cellulose pulp, plasticizers, lubricants, hardening agents, etc., are added to the liquid resin in the next stage, which is conducted in a heated vacuum mixer. This has the effect of drying out the mix which emerges as a coarse white powder to feed to the hot rolls.

The same change occurs here as described in phenolic moulding material production, and the powder becomes a thin sheet which is discharged on to a carrier roll to be transferred to a ramp leading to an elevator which carries the sheet to the top of a crushing tower. Here there is opportunity for visual inspection of the sheets before they pass into a crusher, in operation resembling a gigantic potato-chipping machine. Thereafter the sequence is the same in principle as in the phenolic unit. After crushing the material is ground, sifted, weighed, passed over magnetic separators and fed into drums by a series of automatic processes.

Electrical controls are prominent throughout the entire installation: Temperature cycles are predetermined by this means, and thermostatic control over the temperature of the vacuum mixer, and even of the mixture itself, is provided. Safety devices ensure that if a guard is lifted the machine is rendered inoperative.

Sample tests are taken at every stage and passed to the physical test laboratory by pneumatic tube.

Vybak Unit

The manufacture of vinyl resins and all their derivative products will ultimately form the major part of the activities of Bakelite Ltd., at Aycliffe. One of the three new blocks is to be devoted to the production of Vybak compounds immediately delivery is obtained of the new plant now under construction.

Present production is carried out in a temporary unit achieved by ingenious adaptation of existing buildings designed for some other purpose. An effective production flow has, however, been achieved. Vinyl resins and other raw materials are fed by conveyor into a mixer where they are thoroughly intermixed, and predetermined charges of this mixture are fed into bins on a roller conveyor system. Each batch then passes to a Banbury mixer where the material is masticated; it then feeds by belt conveyor to the hot rolls, where further kneading of the materials takes place.

The rough sheet emerging from the rolls is passed on to a long, cowled, cooling conveyor in readiness for a crushing operation to form the coarse powder or "chips" used for extrusion and cable-covering purposes. The granulated material passes over the standard magnetic separators before feeding into drums for dispatch.

Physical Test Laboratory

Testing is fundamental to the production of good plastics. In few branches of industry is laboratory control over manufacturing processes carried to quite the same degree. As a consequence it is not possible to cover adequately in a brief description the multifarious tests conducted in the Aycliffe laboratories.

One or two of the tests are spectacular

to the layman, as, for example, the testing of the electric breakdown strength of materials in air, a series of flash-overs at 30,000-40,000 volts providing an arresting display. But it is on the dozens of solid informative tests that the real quality of Bakelite plastics is built up. The patient logging of information enables a life history of each grade of material to be compiled and helps in the maintenance of that uniform standard of quality which is vital to a repetition process such as moulding.

Numerous stage by stage tests are conducted as the various types of material are being manufactured. On the finished product all the standard tests to ensure compliance with relevant British Standard Specifications are carried out. Tests for tensile strength, cross-breaking strength, impact strength, plastic yield under given temperature conditions, tests for the "flow" of a moulding material, its flexibility when moulded, its "pourability" and pelleting qualities as a powder, analyses to determine uniformity of granule size, are typical of the everyday investigations carried out in the laboratories. Statement of a material's electrical properties requires tests for power factor, surface and volume resistivity, and yet another wide range of tests is necessary to determine the chemical properties of materials.

All plastics produced at Aycliffe are subjected to tests of this character, although variants are naturally introduced to probe individual properties of different classes of materials. Physical properties of vinyls, for instance, are greatly affected by temperature. These Vybak plastics are therefore tested in a special temperature-controlled chamber. Some of these tests, and others selected from the wide range of standard tests, are illustrated.

Research and development are proceeding continuously, and the laboratories at Aycliffe require detailed information on new materials corresponding with and at times exceeding the data compiled as a routine measure on standard production materials. Many of the aspects of the physical test laboratory, therefore, are to be found duplicated, although on a smaller scale, in the research and development department. Here there are also chemical laboratories, a temperature-controlled chamber for vinyl tests, and all the equipment necessary for physical testing.

Cellulose Acetate for Moulded Radium Applicators

Our recent reference to the application of certain plastic materials in the making of splints for orthopædic use ("Plastics," July, 1948, page 353) has brought us information upon a particular type of cellulose-acetate material which is fairly rigid at ordinary temperature, but extremely pliable when heated to 120 degrees C., and which, on account of this and other properties, finds use in the making of moulded applicators for the radium treatment of malignant disease.

This material, known under the name of "Nidrose," can conveniently be moulded to suit the contours of large areas of the human body, and it has the special advantage of being suitable for a moulded shape which requires to be "sprung" into position, for example, in the case of the neck, a hand or a limb. The sheets are so treated during manufacture that when heated they can be drawn out into a fine meshwork before being moulded upon a plaster cast of any part of the anatomy with which they are ultimately to be in close contact. The resulting shape is stiff enough to hold the radium exactly where its application is needed, and yet flexible enough to be comfortable in use and not to cause extreme limitation of movement. It is sufficiently light in weight to be worn for long periods without causing tender areas at pressure points and, additionally, it allows skin aeration.

When used as a radium applicator, the radium tubes are fitted into a length of rubber tubing with spacer pieces, if necessary, to distribute the tubes evenly; this loaded rubber tube as a whole is then mounted on the Nidrose, taking advantage of the fenestration of that material.

The present source of supply of Nidrose is Bruneau and Co., 17, Rue de Berri, Paris, 8e.

Cellulose Acetate Plastics

XIV.—Weathering and Ageing Properties

By
Vivian Stannett

THE behaviour of a plastic material during exposure to the atmosphere for protracted periods is obviously of great importance when considering its use for a particular purpose. In the case of cellulose acetate plastics, a considerable amount of work has been carried out in this connection, particularly in the case of transparent sheet material. This work has included actual outdoor exposure of samples and examination in the laboratory, using ultra-violet light and artificial weathering to give an accelerated treatment which roughly corresponds to prolonged outdoor exposure under various conditions.

In practice, results from artificial and natural weathering tests are found to agree quite closely. Owing to the smaller surface area involved and the comparative thickness of the articles, however, moulded parts are not so much affected by exposure compared with sheet material. Consequently, less work has been done on the weathering of moulded parts, except with regard to the small changes in dimensions which are found to occur on prolonged exposure.

The main effects of exposure on cellulose-acetate plastics can be grouped as follows: (1) Loss of any residual solvent which may be left in the plastic during manufacture. (2) Effect of light (particularly ultra-violet light) on the cellulose acetate molecules themselves. (3) Loss of plasticizers due to volatilization and/or leaching out. (4) Action of fungi and bacterial growth on the acetate.

Residual Volatile Solvent

The amount of residual solvent (usually acetone) in the plastic varies within the range 0-3 per cent., according to the method of manufacture and the amount of drying or seasoning treatment given. Heavier gauges of sliced sheeting and cast film tend to contain the largest percentage of residual solvent and moulded articles the least. Most moulding powders are virtually free from solvent if correctly made and seasoned; in fact, in many cases no volatile solvents are now used in moulding powder manufacture, this practice being practically universal in the United States.

The loss of the small percentage of volatile solvents takes place slowly under normal exposure conditions and is accompanied by slight shrinking and warping. The amount is dependent on the amount of residual solvent originally present, and film and sheet which have been correctly seasoned during manufacture should be substantially free from these effects. Warping effects are more noticeable in the case of cast films. This is presumably due to the unequal distribution of the residual solvent causing differential shrinkage effects across the two surfaces on evaporation. These faults are not usually experienced with moulded products, as little, if any, residual solvent is found in the case of moulded material.

Effect of Ultra-violet Light

The most important changes in the properties of cellulose acetate plastics which take place on exposure are those due to the effect of ultra-violet light. Although difficult to overcome, these effects can now be considerably reduced by suitably modifying the composition of the plastic; modern cellulose acetate plastics can be exposed to sunlight for long periods without excessive deterioration. The effects are due mainly to a reduction of chain length in the cellulose

Table 1.—Effect of Light on Copper Number of Cellulose Acetate[1].

Material	Exposure (days)	Method	Copper number	
			Before	After
Medium viscosity	63	Acetone solution	2.0	13.45
	42	Acetone solution	2.7	10.00
	34	Acetic acid solution	2.0	13.40
	30	Film (nitrogen atmosphere)	2.0	12.10
High viscosity	33	Acetone solution	1.7	11.03
Low viscosity	94	Acetone solution	5.0	19.4

Table 2.—Dimensional Stability of Cellulose Acetate (Gloor[3]).

Specimen	Test	Property	% Dimensional Change		
			H8 grade[2]	H5 grade	H3 grade
Moulded tensile bar 7½" × ½" thick	Temperate cycle	length	0.1	0	0.2
	Temperate cycle	weight	0.2	0.2	0.2
	Torrid cycle	length	−0.5	−0.5	−0.8
	Torrid cycle	weight	−1.1	−1.1	−1.5
Moulded disc 2" diameter ½" thick	Temperate cycle	diam.	−0.7	−0.5	−0.1
	Temperate cycle	weight	−0.2	−0.2	0.2
	Torrid cycle	diam.	−1.0	−1.0	−1.2
	Torrid cycle	weight	−0.3	−0.4	−0.7
	3 cycles	diam.	−1.4	−1.5	−1.6
	3 cycles	weight	−1.4	−1.5	−1.6
	7 cycles	diam.	−1.5	−1.6	−2.0
	7 cycles	weight	−1.5	−1.6	−2.0
	7 cycles, then reconditioned	weight	−0.7	−0.8	−1.2
Moulded strip 5" × ½" × 1/16"	Temperate cycle	length	0.4	−0.3	−1.6
	Temperate cycle	weight	0.2	−0.5	−0.4
	Torrid cycle	length	0.3	−1.5	−2.0
	Torrid cycle	weight	−1.7	−1.9	−3.2
	3 cycles	length	−1.3	−1.1	−1.6
	3 cycles	weight	−1.5	−1.8	−2.3
	7 cycles	length	−1.4	−1.3	−1.4
	7 cycles	weight	−2.2	−2.8	−3.5
	7 cycles, then reconditioned	weight	−1.4	−1.9	−2.7
Extruded strip 5" × ½" × 3/32"	Temperate cycle	length	−0.1	−0.2	0.1
	Temperate cycle	weight	0.2	0.1	0.2
	Torrid cycle	length	2.8	5.7	4.3
	Torrid cycle	weight	−0.6	0.6	−1.3
			M.S. grade	H. grade	
Skived sheet 5" × 1" × ¼"	Torrid cycle	weight	0.1	0.35	
	Torrid cycle	length	−1.0	−0.8	
	Torrid cycle	width	2.2	−0.1	

acetate molecules by cleavage, although some reduction in acetyl value also occurs. The fall in tensile strength, increased brittleness, and other changes in mechanical properties, which will be described later, are due to this drop in chain length.

The depolymerization of the cellulose acetate is indicated by the fall in intrinsic viscosity of the acetate in solution and by the increase in the copper number which is found to occur on exposure. The copper number is defined as the number of grams of copper reduced by 100 grams of cellulose under specified conditions. Due to free aldehyde groups, an increase in this copper number must indicate that the chains have been broken to form a greater number, or that some primary alcohol groups have been oxidized to aldehyde. This latter possibility can be virtually eliminated, as glucose is found to give no increase in copper number on exposure. Consequently, the increase can be due only to depolymerization.

Table 1 gives some figures of Montonna and Winding[1] showing the notable increase in the copper number which takes place on exposing films and

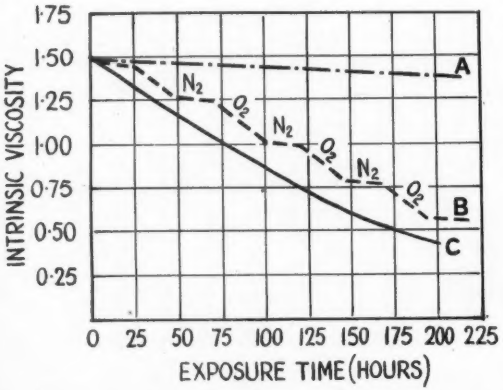


Fig. 1.—Effect of exposure of cellulose acetate film to light under various conditions. (Lawton and Nason.)[2]

A. 5/1,000-in. film in nitrogen atmosphere.
B. 5/1,000-in. film in nitrogen and oxygen alternately.
C. 5/1,000-in. film in air.

solutions of cellulose acetate to light from a mercury vapour lamp, the sample being exposed at a distance of 12 ins. from the lamp. It should be pointed out, however, that the "actual" copper number would be much larger than those quoted, owing to the increased weight of the cellulose acetate repeating unit compared with cellulose. It will be seen from the figures given that a notable increase in the copper number took place after exposure and that the increase seems to be roughly independent of solvent or atmosphere, although later work shows that atmosphere is more important than was then realized.

Cleavage of the molecular chain to produce new aldehyde groups involves the addition of other atoms which were considered to come either from the traces of water inevitably present in the cellulose acetate or from traces of oxygen in the nitrogen.

The depolymerization of cellulose acetate by exposure to ultra-violet light has also been studied[2] by measuring the changes in the intrinsic viscosity of the acetate in solution. The viscosity is also dependent on the molecular weight and chain length, and is inversely proportional to the copper number. Some results of these studies in air, nitrogen, and alternately in atmospheres of oxygen and nitrogen, are shown in Fig. 1. These charts show the deleterious effect of ultra-violet light, and also the important effect of oxygen. The results obtained led the authors concerned to the belief that the chain cleavage is due to photochemical oxidation. In addition to the drop in viscosity, samples also show a slight decrease in acetyl value, particularly when the sample is exposed in an atmosphere of air or oxygen. Further work on the effect of exposure of cellulose acetate to ultra-violet light showed that most of the degradation appeared to

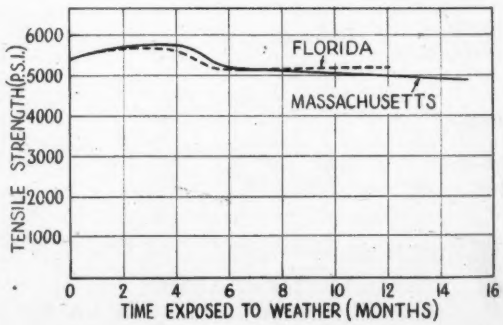


Fig. 2.—Effect of weathering on tensile strength of cellulose acetate.

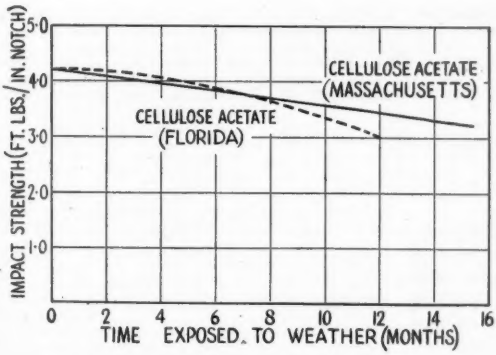


Fig. 3.—Effect of weathering on impact strength of cellulose acetate.

take place at the surfaces of the material.

The deterioration of cellulose acetate on prolonged exposure can also be caused by loss of plasticizer, either by volatilization or by leaching out, e.g., by rain, or by a combination of both. This loss of plasticizer causes shrinkage effects and is naturally at a minimum when a small proportion of plasticizer of extremely low volatility and water solubility is present. In addition to shrinkage effects, this loss of plasticizer also gives rise to brittleness. The choice of such plasticizers has already been discussed in earlier sections of this series of articles, and need not be repeated here. However, it may be mentioned that Lawton and Nason[4] found that in the particular samples they investigated 20 per cent. of the original plasticizer content was lost after one year's exposure in the sub-tropical climate of Florida, and this quantity appeared to have been lost mainly from the surface regions of the plastic.

The breakdown of plastics due to fungi and bacterial growths was investigated in some detail during the war, owing to the proposed use of plastics in the tropics. As far as is known to the author, the work relating to cellulose acetate compositions has not yet been published, apart from the general conclusions that moderate growths do take place and that this tendency can be decreased somewhat by a suitable choice of plasticizers.

The practical significance of the changes which take place on exposure or weathering of cellulose acetate plastics have been studied with considerable care by a number of workers. It is interesting to note that the tendency is to use actual outdoor exposure conditions over very long periods for these trials, rather than accelerated weathering tests. However, Gloor,[3] in his investigations of the dimensional stability of moulded cellulose acetate, used laboratory "weathering" conditions. He used three types of conditions: (1) A temperate-zone cycle, which involved treatment for 24 hrs. at 88 per cent. relative humidity and 140 degrees F., followed by 24 hrs. dry at 140 degrees F.; (2) a torrid-zone cycle involving 24 hrs. at 100 per cent. R.H. and 175 degrees F., followed by 24 hrs.

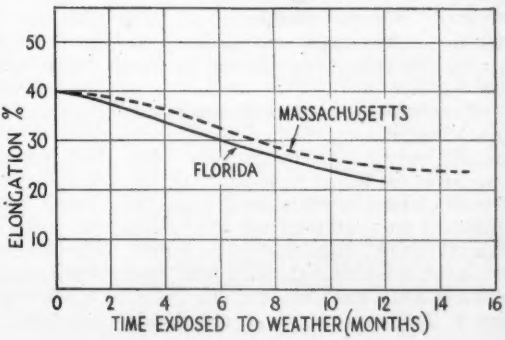


Fig. 4.—Effect of weathering on elongation of cellulose acetate[4].

Table 3.—Effect of Exposure on Haze and Light Transmission of Cellulose Acetate Sheet[4].

Exposure (months)	% Light transmission		% Haze	
	Florida	Massachusetts	Florida	Massachusetts
Original	89.9	89.9	3.1	3.1
3	90.1	90.2	3.6	3.4
6	90.3	90.9	5.0	4.6
9	90.9	91.4	7.3	6.4
12	91.2	92.1	9.8	8.7

at 175 degrees F. dry; (3) repeated cycles involving three or seven temperate-zone cycles. In each case the samples were reconditioned at 75 degrees F. and 60 per cent. R.H. for 24 hrs. before testing.

Specimens tested by Gloor included injection-moulded and extruded samples, as well as test pieces cut from skived sheet. The changes in weight and dimensions resulting from exposure to the three types of conditions are shown in Table 2. In addition to these measurements, the amount of warping and distortion which took place was also studied.

It was found that, in general, thick specimens had the better dimensional stability and that distortion was least for skived sheet and extruded section, and greatest for moulded specimens. This was considered to be due to stresses frozen into the moulded article which are later released under the influence of heat and humidity. Fewer stresses are frozen-in during extrusion, and the baking step in the manufacture of skived sheet was considered to account for the lack of distortion found with this type of material. Stresses moulded-in at right angles to flow were found to cause greater distortion when released by heat and humidity than parallel stresses.

Specimens were moulded under different conditions and their dimensional stability measured. The results of these tests led to the conclusion that, by moulding under certain conditions, the distortion on weathering can be reduced to a minimum. These conditions include the complete filling of the mould at a uniform and rapid rate, and the travelling of the plastics in one direction only

Table 4.—Effect of Exposure on Linear Shrinkage[4].

Exposure (months)	% Linear shrinkage	
	Florida (subtropical)	Massachusetts (temperate)
3	0.03	0.01
6	0.58	0.33
9	1.42	0.96
12	2.18	1.62

and with minimum speed during filling. Other recommended conditions include the use of warm moulds, a total filling time of less than 23 secs., and employing a wide gated mould to give a chance for the material to spread out prior to entering the cavity, thus causing less moulded-in stresses. On the whole, ethylcellulose mouldings showed less tendency to distort on weathering, presumably owing to the superior flow characteristics of this material.

Changes in the properties of cellulose acetate plastic sheet, which take place on prolonged exposure, were studied by Lawton and Nason.[4] They exposed skived sheeting in a temperature zone (Massachusetts) and a subtropical zone (Florida) for more than one year and measured the mechanical and other properties after every three months. The results of these trials for impact strength, elongation and tensile strength are given in Figs. 2 to 4. It can be seen that a decrease takes place in all these properties, whereas the modulus of elasticity increases on exposure. These results would, of course, be anticipated and can be explained by the reduction in the viscosity of the cellulose acetate, i.e., by the decrease in chain length.

The surface of acetate sheeting develops very fine cracks on long

Table 5.—Effect of Composition on Weathering Resistance[5].

Property and limiting value	Exposure (months) to reach limiting value (Florida)		
Sample	A6	A7	A8
Tensile and flexural strength (50% original value)	8	3	>24
Flow temperature (drop to 250°F.) and intrinsic viscosity (drop to 0.75)	8	4	>24
% Elongation (50% original value)	2	2	>24
Crazing (first sign)	4	3	6 (slight)

Composition of samples (parts per 100 cellulose acetate).
(A6) 42 parts diethyl phthalate plus 14 parts triphenyl phosphate.
(A7) 48 parts diethyl phthalate only.
(A8) 36 parts diethyl phthalate plus 5 parts Salol.

outdoor exposure; these are confined to the surface for a time, but eventually, on very long outdoor exposure, deeper cracks develop. As would be expected, the percentage haze increases on exposure, but the light transmission is found to increase slightly. These results are shown quantitatively in Table 3. The increase in light transmission is thought to be due to the bleaching of the cellulose acetate and a definite improvement in colour does result on exposure to ultra-violet light. Shrinkage figures over one year's exposure in the two climatic regions are given in Table 4.

Prevention of Deterioration

It has already been stated that the chief factor concerned in the loss of desirable properties which takes place on exposure is the decrease in chain length of the cellulose acetate itself, which is caused by the action of ultra-violet light. It was found by Kline[6] that this breakdown can be inhibited by incorporating into the composition certain organic compounds, such as phenyl salicylate (salol), which absorbs ultra-violet rays and emits the resultant energy in a less harmful form. Practical weathering tests were carried out by Meyer and Gearhart[5] with compositions with and without salol. The results of these exposure tests gave convincing proof of the value of such inhibitors in delaying the breakdown due to ultra-violet light. The number of months taken for samples of three different compositions to reach limiting values in their mechanical properties is given in Table 5.

The addition of an inhibitor suppresses the effect of ultra-violet light very considerably and deterioration due to loss of plasticizers predominates, whereas with normal compositions the effect of light is overwhelmingly important. The same workers carried out exposure tests in three different regions of the United States, and came to the conclusion that hot southern climates with high altitudes and low moisture content cause most destruction, because these conditions favour the transmission of the shorter and more destructive wavelengths of the ultra-violet light.

A number of inhibitors which are claimed to reduce the effect of ultra-violet light have now been patented. A very recent patent[7] claims that a big improvement in weathering resistance is brought about by the incorporation of less than 15 per cent. of a low-volatility compound of an aromatic hydroxy carboxylic acid and a phenol; aromatic alcohol or cyclo-aliphatic alcohol. Examples quoted include resorcinol disalicylate and hydroquinone diparacresotinate. The use of ultra-violet inhibitors are a recent development.

(*To be continued*)

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(1) *Montonna and Winding*, "*Ind. Eng. Chem.*," 1943/**35**/77; **(2)** *Lawton and Nason*, "*Ind. Eng. Chem.*," 1944/**36**/1128; **(3)** *Gloor*, "*Product Engineering*," 1945/**16**/554; **(4)** *Lawton and Nason*, "*Modern Plastics*," 1945/**22**/*Jan.*/145; **(5)** *Meyer and Gearhart*, "*Ind. Eng. Chem.*," 1945/**37**/232; **(6)** *Kline, S.P.I. Conference, Los Angeles, Feb.* 1943; **(7)** *B.P.* 597,704 (*British Celanese, Ltd.*); **(8)** "*Modern Plastics*," 1946/**23**/*Dec.*/159; **(9)** *J. Polymer Science*," 1946/**1**/217; **(10)** "*Plastics and Resins*," 1944/**3**/*Aug.*/12; **(11)** "*Modern Plastics*," 1937/**15**/*Nov.*/65.

Cast Phenolics for Rubber Formers and Moulds

By D. McPHERSON

AN interesting development involving the use of cast phenol-formaldehyde resins for accurate formers and moulds for the rubber trade has been initiated by Nucas, Ltd., of Slough. This process should be of particular interest to the trade, in view of the difficulty of obtaining glass and porcelain moulds and the shortage of suitable hardwoods.

One of the major limitations of orthodox cast phenolic resins has been the tendency for dimensional change. On this account their use for most precision work is limited. By using an appropriate filler and curing cycle, Nucas, Ltd., have been able to overcome this problem and reproduce a variety of shapes on which shrinkage can be accurately forecast, and dimensions preserved after long cyclical treatment at 90 degrees C. and over. This means that by using elastomer-type moulds, seamless castings of simple or complicated shape can be inexpensively and rapidly produced for all kinds of latex dipping or forming purposes.

The facility with which a black colour can be produced in the castings ensures that maximum efficiency is obtained when infra-red is employed as a heating medium. One of the few good properties of orthodox cast resins, that is, their ability to take high lustre, via the buffing wheel, is exploited to the full. A finish comparable to that of polished glass is

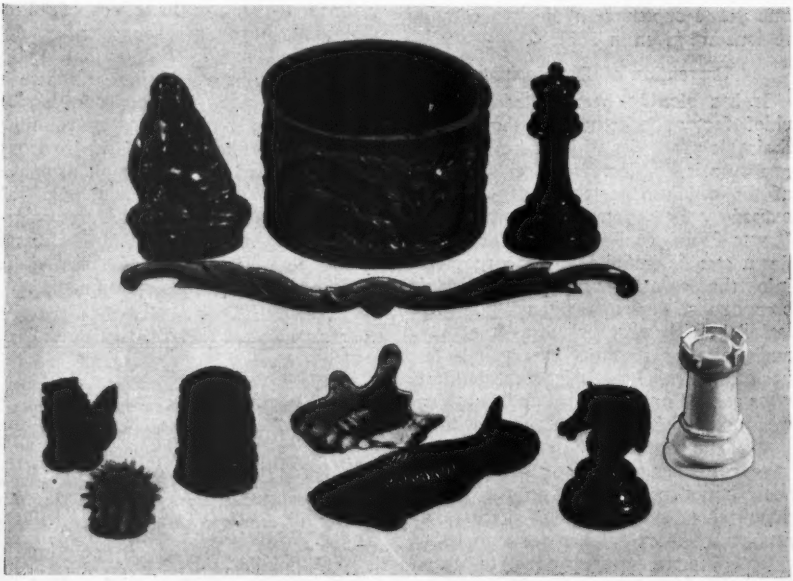


Fig. 1.—These articles of cast phenolic resin have surface polish as taken from the mould; they have not been mechanically polished.

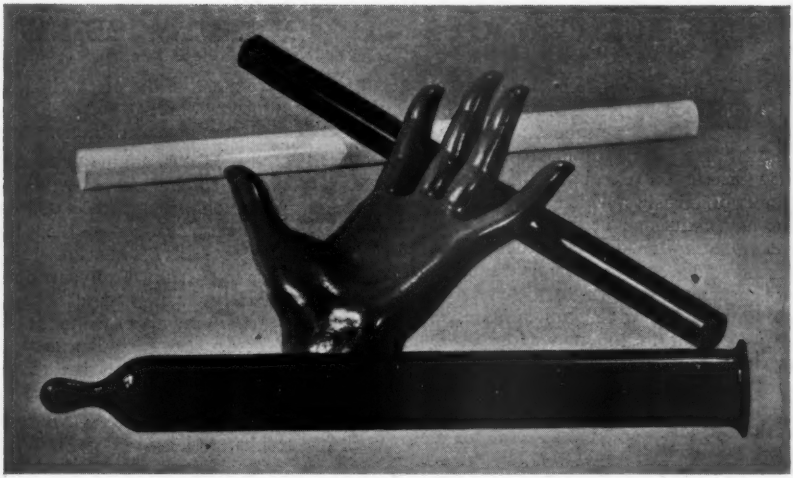


Fig. 2.—Among these cast phenolics are rods for general machining purposes, and a hand for making rubber gloves by dipping.

readily obtained, and the smooth, pit-free inert surface becomes an ideal latex-forming medium.

The accompanying illustrations indicate the precision and complexity of some of the castings which can be produced. Not all of these are applicable to rubber forming or industrial application, because the requirements do not involve such a range of detailed reproduction. However, given an inexpensive forming process, as distinct from the costly and laborious tool or wood carving, it is possible that existing scope can be vastly extended.

Being resistant to most acids and unaffected by humidity or atmospheric corrosion, phenolic products may be safely employed for a variety of specialized purposes. If required, the composition can be modified to be completely inert to caustic solutions of any strength. To produce a required form in quantity, a prototype in metal, wood, cast resin, or for less accurate purposes, plaster, is first prepared. From this a mould is taken and castings are then produced in the orthodox manner. By employing p.v.c.-type or elastomer moulds, a finished article can be taken direct from the mould. If a super finish is required, buffing and polishing are employed as a final operation.

Just as accurate forms can be made, so also can moulds be manufactured. As the cast resin is dimensionally stable, metal locking pins, threaded inserts, and ejectors can be incorporated in any desired location. Again, heat resistance and chemical inertness make such moulds ideal for many rubber and polythene moulding applications. The low cost and speed with which moulds can be made, make the advantages self-obvious; when this advantagee is added to the great saving in weight especially in multiple moulds, the process becomes quite unique.

"Thermos" Registered Trade Mark

In our July issue a photograph of a vacuum flask appeared under the heading: "Thermos Flask." This description was, of course, an error on our part as the flask was not manufactured by Thermos (1925), Limited, who have the exclusive right to the use of the trade mark "Thermos" in relation to vacuum flasks and other vacuum vessels. The correct heading should have been "Vacuum Flask."

Electrical Grades of German Plastics

FIAT Technical Bulletin T-47, recently published by H.M. Stationery Office (price 2d.), is a modest leaflet of only three pages, but it provides some very useful details about the electrical grades of plastics which were made in Germany during the war years. The information included is actually in the form of answers to problems which were of particular concern to Federal Telecommunications in the United States, and now brought to the notice of a wider circle of interests by the British Intelligence Objectives Sub-committee, to whom we are indebted for permission to make extracts.

Polyisobutylene

Polyisobutylene, for use as a cable sheath (Oppanol ORG), was employed as follows: 1 part polyisobutylene (mol. wt. 200,000), 1 part carbon black, 1 part graphite. No antioxidant was necessary. When unloaded material was used, up to 20 per cent. polyethylene (Lupolen N) or "hard wax" (Fischer-Tropsch high molecular weight paraffins) were added to aid in extrusion and to raise the flow point. The foils of Oppanol contained 10 per cent. polystyrene and were calendered.

A heavily loaded material finding some uses, contained 20 parts polyisobutylene (mol wt. 2,000,000), 67 parts talc, 5 parts montan wax, 8 parts carbon.

Styrene Butadiene Copolymers

Regarding special styrene butadiene copolymers of a resinous nature, the principal copolymer was Buna S with 20 per cent. styrene. Buna SS, with 40 per cent. styrene, had better electrical properties but poorer mechanical properties at low temperatures. Considerable work on improving the electrical properties was done through 1942, but the stress then placed on cold-resistance caused the work to be dropped, and it has not yet been resumed.

At the end of 1942, requirements for the best electrical copolymer were:

(a) In approximate order of excellence, the best stabilizers were: oxycresyl camphene, azobenzene, cresol methane.

(b) Mekal BX (the sodium salt of diisobutylnaphthyl sulphuric acid with 25 per cent. sodium chloride), with paraffinic acids (no linoleic acids), was used as emulsifier. Mekal BX, somewhat purified by salting out from a solvent, and with somewhat less salt, had also been used as an emulsifying agent without any addition of acid. Larger quantities of Mekal BX, up to 4-5 per cent., had to be used when there was no additional acid.

(c) Alkaline polymerization gave best electrical results.

(d) Precipitation of the latex with carbonic acid gave the best electrical results.

(e) Curing with sulphur, while exposed to hot air, actually gave better results than curing in steam with air excluded.

Vinyl Compounds

From the work of Dr. Wuerstlin (I.G. Farbenindustrie) on the electrical characteristics of polyvinyl compounds, the best electrical results obtained with the following preferred ingredients and treatment:—

(a) The best plasticizer for electrical purposes was Plastomal TAH (dithiobutyric acid ester of 2-ethyl hexanol); the next best, Palatinol F (phthallic acid ester of Fischer-Tropsch 7-8 carbon alcohols.)

(b) The best stabilizer was sodium carbonate, although other good stabilizers included alphaphenyl indole and diphenylthiourea, but these were actually much better if soda was used with them.

(c) Generally speaking, the use of fillers was discouraged, because of the retrogression in desirable physical properties, such as tensile strength, low temperature, flexibility, etc. If fillers had to be used, they were chosen from barium sulphate, kaolin, kieselguhr, etc.

(d) The requirement for colouring is that the colour be insoluble in the

plasticizers. The preferred colours were azo dyes, precipitated on neutral materials, such as the fillers listed above. Any objection to fillers was overcome by using very small amounts.

Plasticizers like G-25 were available, but were not used with polyvinyl chloride for the following reasons: (a) Only a very narrow range of molecular weights are useful as plasticizers. (b) The Germans did not make a polyethylene cable sheathed with polyvinyl chloride, and the problem of migration of plasticizer never came up.

A typical composition of polyvinyl chloride insulation was: 80 per cent. polyvinyl chloride and 20 per cent. Plastomal TAH. Such an insulation was good for temperatures up to 70 degrees C., when not under pressure; under pressure, the top temperature drops to 50 degrees C., and 40 degrees C. is recommended for safest operation.

Chlorostyrene

If the Germans made any p-chlorostyrene, 2.5 dichlorostyrene or other derivatives, or obtained any information concerning their polymerizing characteristics, handling characteristics and electrical and physical properties of the polymers prepared therefrom, the results of their work in this field appear to have been unrecorded.

Copolymers of Styrene

Concerning the development of copolymers of styrene, especially those with acrylates and methacrylates, vinyl naphthalene, vinyl carbazole and condensation products with maleic anhydride leading to alkyd resins and enamels, it appears that a mixture of 50 per cent. styrene, 25 per cent. acrylonitrile and 25 per cent. vinyl carbazole was copolymerized and could be injection moulded. The moulded parts would withstand boiling water without deforming. A mixture of 75 per cent. styrene and 25 per cent. acrylonitrile was also copolymerized.

Maleic anhydride resins were made by the I.G. and sold under the designation KM (K for "kolophonium" and M for maleic anhydride). Rosin (kolophonium) maleic anhydride and a polyhydric alcohol containing three or more hydroxyl groups (glycerol, pentaerythritol, etc.) were reacted and sold as enamel ingredients, usually for the so-called long-oil type of enamels. Due to the scarcity of drying oil in Germany this field was not intensively developed.

Vinyl carbazole, with up to 20 per cent. styrene, were copolymerized, but found little application.

Wire Enamels

The wire enamel developed during the war and used in an ever-increasing percentage, was a mixture of urea formaldehyde resin (Plastopal AT) and phenol formaldehyde (Luphen B) in the proportion of three parts of the former to one part of the latter. The mixture was plasticized with a super polyester. The all-round characteristics were said to be excellent. Competition from Formex (known in Germany as "Mowital") was attempted, but apparently never developed beyond the laboratory.

The polyamides (German trade name "Igamid") were extruded on wires and tested as insulation, but there were serious shortcomings on testing which were described as "wet cracking." When Igamid is put under tension, and then made wet, it will break at the points of greatest tension.

Considerable promise, at the laboratory stage, was shown for insulation made up of mixtures of the polyurethanes (Desmodur) and polyisocyanates (Desmophen), but even the laboratory tests were not complete when the war ended, and apparently no further work in this direction has been done.

IMPORT RESTRICTIONS.—The Board of Trade announce that a new consolidated list of import restrictions has been issued. This incorporates all amendments made to the former list, which was issued in March, 1947, in so far as they are still operative. "Control of Imports into the United Kingdom, Notice to Importers No. 292," may be obtained from Import Licensing Department, 189, Regent Street, London, W.1.

Plastics at Hanover Trade Fair

THE notable expansion of this year's Hanover Trade Fair, from about 1,200 to more than 2,400 exhibitors, has not produced any better representation of the plastics industry, largely still due to lack of raw materials and production equipment, but a number of the larger firms exhibited and revived somewhat the splendour of pre-war Leipzig Fairs.

Venditor, the sales organization of the Dynamit A.G., Troisdorf, and International Galalith Gesellschaft, Hamburg-Harburg, had relatively large stands; attention was drawn to their compressed-wood components. Complicated moulded parts for mechanical and electrical use, cut gears and a range of electrical hand tools in shock-resistant plastic housings were shown by R. Bosch, Stuttgart. Moeller and Co. exhibited plastic household goods, as also Presstoffwerk Schoeppenstedt, Paul Schnake. Screw caps for bottles, jars and boxes were included in the exhibit of Metallwerke A. Hopf, Noerdlingen, and Guenther Wagner, Hanover; Fr. Moeller showed plastic picture frames. Brake linings with phenolic resin as binder were seen on the stand of Juridwerke K. Kirchbach, Düsseldorf, formerly of Coswig, Saxonia. Artificial teeth and other dental articles were shown by W. Breiter, Schötmar; Zentra-Apparatebau showed the necessary hydraulic presses for dentistry.

The Ruter watch, a useful combination of sundial and compass, i.e., without mechanical movement, is now made in a light-metal housing for the export market, but for the home market it still has a phenolic resin moulding. Metal stools for workers with a seat of "Trolitan," a phenolic resin made by Dynamit A.G., were exhibited by Prinz and Co. Dr. Schirmacher and Co., Hamburg, introduced Plastix-Talisman spectacles, utilizing simultaneously a safety glass and a substance similar to Polaroid to give protection against dazzling.

Moulding presses for the plastics industry seem to be a rare manufacture in Germany. Brockhaus Soehne and Werner-Pfleiderer appear to be the only firms making this line. The latter showed some hydraulic presses and their rubber mixer. Keller and Prahl, Eschwege, exhibited machines for lacquering wire, machines for producing tubular electrical insulation, and equipment for the impregnation of textiles.

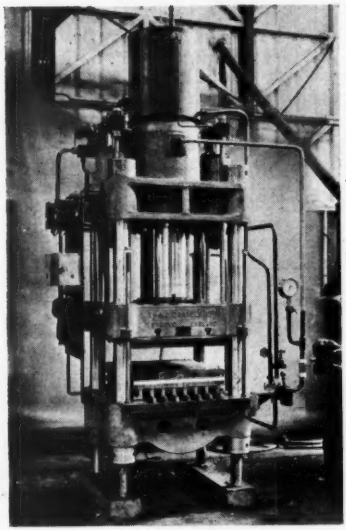
The German rubber industry appeared to be well represented. A high degree of perfection has been reached in the development of special rubber mountings, combining metal and rubber. Such components were shown by Continental Phœnix and Getefo; and by one of the firms who have left the Russian occupied zone and who have developed a new rubber bonding material, and "ersatzstoffe" for shoe soles, etc. R. Benz, Wuppetal, showed artificial leathers on a nitro-cellulose basis for suitcases and as shoe leather. The scarcity of natural leather has compelled more manufacturers of leather goods to use the synthetic variety. Dress shields of "Igelit," a polyvinyl chloride with properties similar to rubber, were a feature of the exhibit by Joseph Beyer, Hamburg.

South African Toys.—Toys fashioned from plastics are now produced by a recently established firm in Pietermaritzburg. The Department of Commerce and Industries also reports that highly mechanized plant, specially designed for mass production, has been installed by a firm in Johannesburg for the manufacture of a wide range of plastic articles of its own design. Shop fittings, shoe fillers, skirt markers and various lines of fancy goods are being made from plastics by a Port Elizabeth firm.

The Index for "Plastics," Vol. 11 (January to December, 1947), is now published. Copies may be obtained from Temple Press Ltd., Bowling Green Lane, London, E.C.1, price 7d. each, post free.

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes



MOULDING PRESS.—The 150-ton moulding press which is the subject of our illustration was exhibited by T. H. and J. Daniels, Ltd., of Stroud, at the 1948 British Industries Fair. It is of the down-stroke double-acting prefilling type, with 12 ins. main ram and a maximum stroke of 14 ins., being self-contained, with its own high-speed driven pump; the hydraulic medium is oil. Control is effected by means of a single-lever piston valve. Electrically heated platens, with thermostatic control, are fitted. The press is being used for the moulding of a variety of articles in Bakelite and Beetle, ranging from electrical plugs, switches, etc., to beakers and vacuum cleaner components.

THE BOARD OF TRADE announce that the Plastics Materials Section of the Raw Materials Department has removed from Horseferry House, Horseferry Road, S.W.1. Inquiries should in future be addressed to the Board of Trade, Plastics Materials Section, Millbank, London, S.W.1. (Telephone: Whitehall 5140.)

THE GAUGE AND TOOL MAKERS' ASSOCIATION will present a composite display of precision products from the British gauge and tool industry at the All-British Exhibition to be held in Copenhagen, Sept. 18 to Oct. 3, 1948. The stand will be divided into sections featuring (1) gauges and measuring equipment, (2) jigs and fixtures, (3) press tools, (4) moulds and dies, (5) engineers' small tools, (6) diamond tools; and will also include an inquiry bureau. The secretary of the Association will be in attendance throughout the period of the exhibition. Over thirty member firms will be represented by exhibits. The Association is also arranging for a party of members to travel to Denmark to visit the exhibition.

TOYS AND INDOOR GAMES.—Restrictions on the manufacture and supply of toys and indoor games for the home market are to be lifted from July 31. Many of the materials used in their manufacture will, however, still be subject to allocation.

TELCOTHENE BOTTLES.—The Telegraph Construction and Maintenance Co., Ltd., inform us that the information which they originally gave us regarding their "Telcothene" laboratory bottles, described in the July issue of "Plastics" (page 369), was not strictly correct. All these bottles are made from polythene only, and there is no admixture of polyisobutylene.

BISOL ORGANIC CHEMICALS.—It must be about 20 years ago that we saw the birth of this now famous chemical organic manufacture by British Industrial Solvents, Ltd., and well remember their first booklet sent to us. It then contained descriptions of a dozen or so of technical solvents, the high purity of which fostered so much the exceptional quality of finished synthetic enamels and general organic products. The booklet now issued by the company still retains the original style of presentation with analysis, B.S. specifications where applicable, and commercial information, but has now swollen to include more than 80 solvents, plasticizers and softeners, and organic reagents. Of relatively new plasticizers and solvents, etc., for the plastics industry we note the production of dioctyl phthalate and dioctyl sebacate, methyl glycol phthalate and 2-ethyl hexanol.

M AND B PLASTICS, LTD., of 3, Wimpole Street, London, W.1, are now producing a new plastics film, "Ethulon," which has been specially evolved for use as a tracing material and in the photo-reproduction section of the printing industry. In use, no talcing or other preliminary treatment is needed. The adhesion of ink is high, and it does not chip off when the film is creased. The high dimensional stability of the material, however, is claimed to be one of its notable qualities; there is no tendency to warp or cockle, even at extremes of humidity or on immersion in water. Moreover, water sprinkled on a sheet of "Ethulon" will not impair its flatness, nor produce any sign of differential expansion. The tear strength of the new material is claimed to be higher than that of any other plastics film.

DE LA RUE INSULATION, LTD., state that the bar and table tops of the Lansdowne Restaurant, Berkeley Square, London, have been redecorated with "Formica," which is proof against cigarette burns and also unscratchable. The finish is in green linette to tone with the rest of the colour scheme. The installation was carried out by Perma Tops, Ltd. "Formica" has also been used in a similar manner in a number of other London premises in recent months, including the Princes Bar, Piccadilly, and Madeleine Bar, South Molton Street.

PUNFIELD AND BARSTOW (MOULDINGS), LTD., announce that Mr. G. J. Jennings became a director on July 1.

MICA PRODUCTS, LTD.—Mr. N. A. Evans, who has been employed by this company for the past 11 years, has recently returned from the Forces. He has resumed his duties as representative in the South East London area.

MR. W. H. STEVENS, A.R.C.S., F.R.I.C., F.P.I., consulting chemist, finds that many of his friends and former clients are not familiar with his present whereabouts and asks us to state that he may be addressed at 15. Hawthorne Road, Bickley, Kent, where he maintains his laboratory. (Telephone: Imperial 3971.)

VISITOR FROM THE BAHAMAS.—Mr. J. W. Shillan, at one time managing director of British Motor Boat Manufacturing Co., is visiting this country to obtain exclusive agencies (including plastics) for the West Indies' market. He is staying at The Close, Bodicote, nr. Banbury, Oxon.

PLASTIC INSTITUTE NOTES

Training Grant Awards, 1948.—Fourteen applicants applied for training grants. The general feeling of the committee was that the candidates were very good young men who had more interests and vitality than those interviewed during the war years The training grants were awarded to G. C. Abel (Kodak, Ltd.); J. Farago (Dr. Yarsley): C. W. Hodge (I.C.I., Ltd.); F. S. Cadd (Orb Engineering Works, Ltd.); R. Dyer (I.C.I., Ltd.); and K. Regan (I.C.I., Ltd.).

Annual General Meeting.—The annual general meeting of the London Section was held at the Waldorf Hotel on July 21, when Dr. P. C. Young was elected chairman for the year, and Mr. H. F. Judd was re-elected hon. secretary. Mr. A. J. Gibson and Mr. M. Appley were elected to the committee.

NOTES FROM THE BRITISH PLASTICS FEDERATION

New Members

ENGINEERS' GROUP: Jaru, Ltd.

LAMINATED AND FIBROUS PRODUCTS GROUP: Insulating Materials, Ltd.

Trade Literature Overseas

An appeal is being made to members of the Federation to assist British Embassies, Consulates and Trade Commissioners overseas by sending them copies of their trade literature, in order that commercial libraries may be kept up to date and information on U.K. products may be readily available to inquirers.

Exports

The Federation has made detailed inquiry regarding available exports of plastics materials, for the guidance of the Board of Trade in connection with trade negotiations.

Plastics in Norway

The Norwegian Industries Development Association have recently formed a Plastics Section, and arrangements have been made for co-operation between this Section and the Federation.

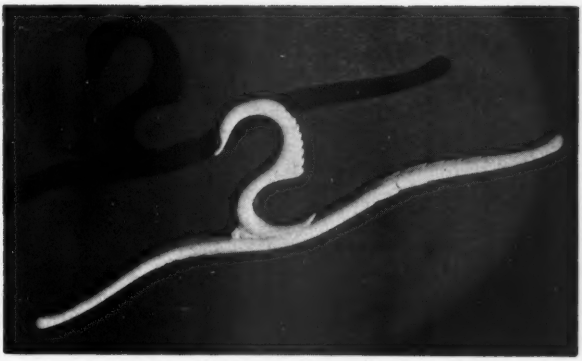
Moulding Powders Imports

Imports of moulding powders during May were as follows:—Phenolic, 362 tons; urea, 12 tons; polystyrene, 98 tons; cellulose acetate butyrate, nil.

Information Bureau

The Federation's Information Bureau continues to act as a general inquiry centre for the plastics industry; it also assists in establishing contact with manufacturers.

New Productions from the Moulding Shops



Child's Coathanger

This coathanger, for children's use, is injection moulded in ethyl cellulose for the British home market. It can be made of either polystyrene or ethyl cellulose for export. The design is by Mr. E. J. Doudney, A.R.B.S., M.S.I.A.; the moulding, by Halex, Ltd. An illustration of one of the hard-nickel electro-formed moulds employed was published in "Plastics," March, 1948 (page 134).

Berth Lamp

An electric light fitting for the illumination of berths on board ship offers wide and interesting possibilities for the designer. The berth lamp illustrated is particularly neat and attractively streamlined. It is moulded in "Beetle" by Brookes and Adams, Ltd., of 250-252 Barr Street, Hockley, Birmingham, 19. The wall fixture is green; the shade is cream.

Medicant Sprayer

Although of American origin this medicant sprayer—a product of Colman Corporation, Los Angeles, California—has such an unusual construction that its inclusion on this page, normally devoted to British products, appears justified. The plunger assembly is moulded in rigid "Vinylite," taking advantage of the dimensional

stability, chemical resistance and non-toxic qualities of that material. The bottle, of polystyrene, has the same desirable features, but its crystal clearness allows instant observation of the amount of solution remaining while the spray is in use. (Photo by courtesy of Bakelite Corporation, U.S.A.)

Quality Control in Plastic Moulding—IX

In this section further consideration is given to alternative forms of fraction defective charts and methods, with particular reference to multi-impression tools.

By W. M. HALLIDAY

IT will be recalled from the preceding article describing fraction defective methods of inspection and charting in reference to the production from a typical 10-impression injection-type mould, that sample groups of mouldings were taken at regular intervals, but in quite a random fashion from the bulk quantity of articles produced within the period. One very important point, however, arises in connection with the taking of samples in this manner.

Limitations of Random Sampling

By random, it is implied that *all* the components produced in the interval since the previous check are carefully segregated or isolated from earlier similar productions, and a certain number or proportion is then selected and checked to determine the fraction defective. The proportion thus chosen for checking purposes is taken indiscriminately, which means that any single plastic moulding is as likely to be chosen as another.

Two points arise in this connection which deserve careful study.

The first is that the above method of taking samples may actually involve considerable unnecessary checking or gauging in those cases where the plastics mould is well capable of producing the components *amply within* the specified limits of variation. It very often happens that a plastic moulded part has not to be held to close dimensional tolerances at all on any portion; surface finish and general appearance being the prime requisites demanding the attention of the moulder and inspector.

In these conditions the mould may well produce consistently satisfactory articles to such wide limits. Therefore if a relatively large proportion of individual mouldings were to be selected to comprise a sampling batch, a superfluous amount of sampling and checking may in fact be conducted.

In actual practice the quality control inspector would easily be able to make a suitable adjustment by reducing the size of the sampling batch taken at the end of each period, and also to increase the interval of time between taking such samples. By this simple means he would speedily be able to reach the most suitable and economical scale of sampling suited to the particular job.

Especially will this be so if the production has progressed for an appreciable time, so affording very reliable guidance to him as to the capacity of the mould and moulding process generally to sustain manufacture to the required limits.

Random Sampling from Multi-impression Moulds

The second point relates particularly to sampling from multi-impression moulds. Obviously with any form of sampling from such multiple-cavity tools, the inspector should be assured that any samples taken for gauging are truly representative of the mould output.

If individual moulded components comprising such sample batches are taken quite at random as already explained, it may well be that the quantity of mouldings from each cavity will vary enormously; so much so that, in the case of, say, a 48-impression tool, it may happen that scarcely any mouldings produced from one or two cavities may get checked due entirely to the *haphazard style* of taking samples. Should this undesirable feature

occur faulty mouldings may be produced from one or two of the 48 cavities, and yet remain entirely unrevealed for a considerable time.

To obviate such an occurrence, therefore, it will be advisable to adopt a slightly different sampling procedure. Provision should be made at the injection machine for a complete spray of every moulding produced per shot to be retained intact with sprue waste, runners and gates. These sprays would have to be carefully stacked in trays, or in suitable containers, so that when the inspector made one of his periodical visits he would be able very easily to check the full complement of mouldings on a spray; he would, of course, take a certain number of full sprays instead of so many individual mouldings.

With other kinds of plastic mouldings produced from multi-impression tools, notably those for the compression form of moulding, individual mouldings are not normally jointed by runners and gates, but issue from the mould entirely separate and distinct from adjacent ones. Therefore some other method has to be employed for ensuring that an approximately equal number of mouldings is taken from each cavity.

Very often it is quite practicable to mould some simple identification mark or number on to one of the inner or non-essential surfaces of the component, so that it may readily be determined from which cavity it has been formed. Where such a method can be adopted the finished articles when produced from the mould may well be placed in a large container, leaving it to the visiting inspector to sort out a more or less equal quantity of mouldings issuing from each cavity in the mould. This method, of course, would involve considerably more time for such inspection operations.

On the other hand, with very many compression mouldings, especially where these possess substantial wall thickness and a resultant much longer curing time, it might easily prove possible and most convenient for the operator to sort out the mouldings produced from the preceding "lift" whilst one set was being cured in the press.

If a container were to be provided having a suitable number of partitions or compartments to equal the number of cavity impressions in the mould, this task of sorting out the mouldings may be very much simplified, and the subsequent selection of sample batches truly representative of every cavity in the mould rendered more easy and reliable.

Where no such identification marking can be permitted on the finished moulded articles reliance will necessarily have to be placed upon the mould operator to ensure that components from the respective cavities are now allowed to become indiscriminatingly mixed together.

Sometimes it is possible to provide slots in the top surface of the stripping table, or a plate attached thereon, the slots being positioned exactly coincident with the cavities of the mould block. The slots would also be made slightly larger in all respects than the overall dimensions of the finished mouldings. Thus by employing such a slotted stand or plate the mould when removed from the press platen after curing would be placed parting-line surface downwards on the stand. Positioning strips should be provided to ensure that the mould block was located correctly so as to bring the cavities exactly above the slots, in the stripping table. With the mould block so located relative to the slots the ejector plugs would be withdrawn to allow the finished components to fall out of their cavities through the slots in the stripping table, and into suitably numbered containers located underneath the stand.

By this simple and inexpensive expedient all the finished mouldings would be very quickly and correctly sorted and segregated from each other in proper relationship to the cavities from which they had been produced. Sample batches of parts would then be selected from each of the numbered containers and plotting made on the control charts according to the data secured.

Where differences of either dimensions, surface finish, or some other important feature occurs on mouldings produced from a multiple impression mould, some care will be required in the actual gauging of the parts and the subsequent charting of the results of such gauging.

Gauging and Charting for Variations on Mouldings from Different Cavities

It will at once be obvious that it will not be safe for an inspector to ignore the extent of such variations shown by different mouldings issuing, say, from one or two slightly erroneous cavities, because this may not influence the scale of the fraction defective average percentages from which plottings are made on the control chart to an amount sufficient to afford a true picture of what is taking place. To avoid such a misleading result, it will be advisable to gauge or check those moulded parts from the cavities most prone to error with greater frequency and additional care.

With some multi-impression moulds it may be found that a certain dimension only shows undesirable variations over the various cavities. In such cases it may prove more convenient and reliable to plot two control charts, one for all the other lesser important features, and one for the particular dimension to be closely controlled. The average values of $\bar{p}$ upon which the control limits are based would be separately calculated for each control chart.

Variations of Several Features on a Single Component

With the moulding of certain kinds of plastics components, which have *several* characteristics to be controlled by fraction defective means it is sometimes necessary, or indeed highly desirable, for the inspector, mould setter or productive engineer to be able to determine *which characteristic* is exhibiting the *greatest variation*. Furthermore, it may prove extremely important to ascertain quickly the frequency or magnitude of such variations or errors, in order to institute corrective action with greater exactitude.

In order to accomplish such an objective with greater reliability several control charts may have to be introduced on the job. The first main chart should be used for recording the progress of the production based on the information afforded by grouped sample batches in the manner explained in the previous article.

To illustrate how this form of control would be arranged let us suppose that a plastic moulding has to be produced having four essential features A, B, C and D, which must be carefully controlled. A, B and C are dimensions on the part, each being checked by the usual type of "go-not go" gauge. Feature D is the weight of the component, this being checked by means of a simple weighing operation, in comparison to a standard master piece of correct weight.

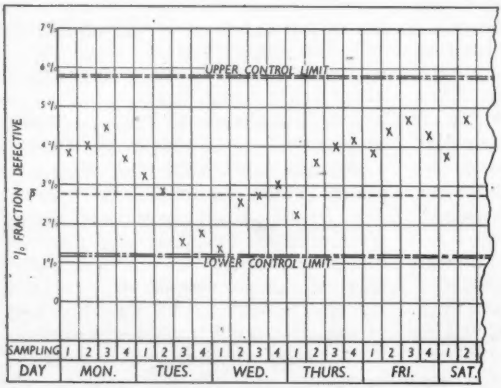


Fig. 1.—Type of main chart as used for controlling several features on a moulded component.

The first and main control chart depicted at Fig. 1 is used for recording the production variations of all four features. This chart is based on the value $\bar{p}$ of 2.75 per cent., which value has been ascer-

tained identically in the manner described in the preceding section of this series.

Groups of 24 samples are selected from production at intervals of every two hours. Ten sample batches were taken in the first instance for the determination of the control limits for the chart. As will be noted, the upper control limit is fixed at 5.8 per cent. and the lower control limit at 1.2 per cent. The central limit is $\bar{p}$, that is, 2.75 per cent.

Plottings have been made on this chart covering practically a full week's production run from the mould, to illustrate its operation. The positions of such plotted points indicates that the production was maintained within the requisite control, since every point lies between the outer control datums. However, it will be specially observed that considerable variations must be occurring, as shown by the wide disparity in the locations of the plotted points. Really stable, uniformly accurate production would be revealed on the chart by a much more general location of the plotted points about the *central control datum.*

Such a chart records the average variations of all four features, but where the plottings are widely dispersed between the control lines, one or more of these features may be outside the limits imposed. Therefore, to ascertain this vital information, a second chart, as illustrated at Fig. 2, is employed.

This chart is actually a composite one, consisting of four distinct graphs. Each one is arranged to apply only to one feature. Thus the upper chart is for feature A, which is the .500-in. diameter on a certain portion of the component.

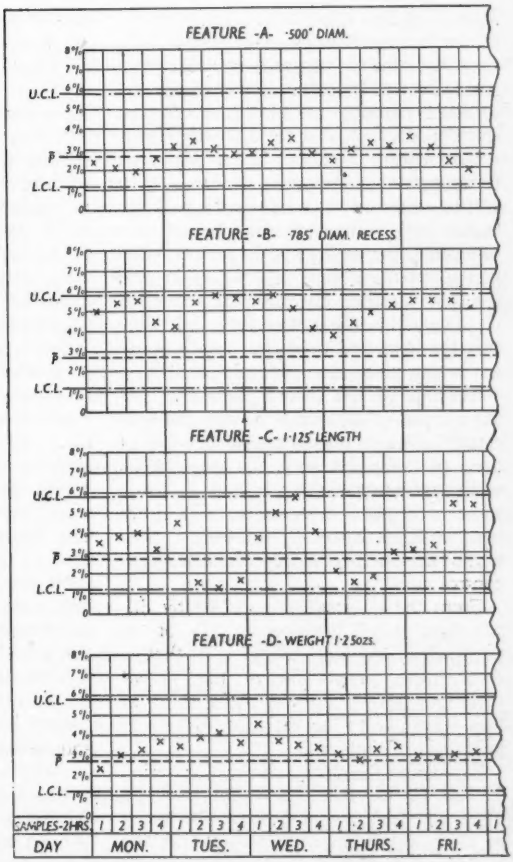

FEATURE -A- ·500" DIAM.
FEATURE -B- ·785" DIAM. RECESS
FEATURE -C- 1·125" LENGTH
FEATURE -D- WEIGHT 1·25ozs.
U.C.L.
L.C.L.
p̄
SAMPLES-2HRS. 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
DAY MON. TUES. WED. THURS. FRI.

Fig. 2.—Set of four sub-charts to reveal variations occurring on each feature of the moulding.

The second chart is for feature B, the diameter of a recess, which has to be maintained at .785 in. diameter plus a specified tolerance. The third chart is for feature C, a length dimension of 1.125 ins., whilst the fourth chart is for the weight of the moulding, i.e., feature D.

These charts are made half the scale size of the main control chart shown at Fig. 1. The days of the week and period of the taking of samples are denoted at the foot of the composite chart, and not for

each of the four sub-charts. The positions of the control datums in each case have been reproduced identically from the main chart, as will be seen. These charts are depicted partially completed to cover a short production, as in the case with Fig. 1.

Considering first the upper sub-chart for moulded component feature A, it will be observed that the accuracy of this feature was consistently maintained over practically the entire weekly period. The plotted points hover very closely around the central datum corresponding to value $\bar{p}$. From this chart, therefore, it is clear that the suspected excessive variations are not taking place in respect of feature A.

Turning to the second sub-chart, for the control of feature B, a very different state of affairs is plainly indicated. Whilst every plotted point lies *within* the compass of the two outer datums, it is evident that some doubtful components must have been made by reason of the strong inclination of the plottings to approach the upper control limit.

From the information supplied by this sub-chart, it will therefore be safe for the production engineer to take it that a considerable proportion of the violent variations shown on the main chart at Fig. 1 are due to the variations occurring in respect of feature B.

Examining the third sub-chart, covering feature C, we find the variations even more extensive, ranging from the lower to the upper control limits in an almost haphazard fashion.

The fourth sub-chart, for feature D, is actually the most stable of the set, this being demonstrated by the steady and consistent proximity of most of the plottings to the central control limit.

Gathering up the information afforded by these four sub-charts, it is clear that the seat of the suspected troubles lies in connection with features B and C respectively, since these are shown to be varying the maximum extent. Therefore attention should be given to the mould or the portions thereof which determine the accuracy of these parts.

It will be appreciated that an even more accurate picture of the vagaries of this production operation could be obtained if the control limits provided on the four sub-charts were to be closer than those needed for the main chart as at Fig. 1.

In actual practice, when the inspector desires a very accurate picture of the variations taking place in respect of any particular features, a new value for $\bar{p}$ would be ascertained for each sub-chart. A number of sets of samples would be taken regularly from production, and the range of variation occurring on the particular dimension would be noted. Average values would then be calculated to determine the positions of the datums on the sub-charts.

In application to a production run, the main sub-charts could all be compiled simultaneously. This method, of course, entails some additional gauging and a little extra time in filling up the charts beyond that required when a single chart only is used.

On the other hand, the main chart may be compiled on the basis of sets of samples taken from production every hour, whilst the sub-charts could be compiled from sets of samples taken once every two hours. This method would permit of the reduction of the additional gauging time, and would also economize in the inspector's time to some extent.

As will be appreciated, use of composite sub-charts of the above-mentioned kind, in cases where a number of dimensions or features have to be controlled, can afford great guidance to the inspector or a production engineer. The great advantage arising from their use lies in the manner in which they focus attention upon the variations of each feature of the finished production as production proceeds. Thus the extent and causes of undesirable variations or faults are much more closely shown up, and much time will be saved when conducting investigations for the causes of such variations. The inspector will be able to stipulate with great assurance which particular feature is out of control, or most prone to vary, together with clear indications of the amount of such variations.

When inaugurating production from a new plastics mould it is often very helpful, and in some cases necessary, to specify at the very outset a predetermined maximum level of average quality to which the products must be produced. This is often highly desirable because it lays down a certain standard of quality or accuracy as a target to be attained, throughout the ensuing production operations.

Control Limits Based on a Predetermined Standard of Variation

One chief advantage from the setting up of a standard level of variation permissible on the job is that when a new mould is put into production use for the first time, the need for corrective action or adjustment, as revealed by a normal control chart, may become ignored or overlooked. This will be due to the fact that the control limits for the chart will have been derived from *purely average values* taken from samples of a production run. In other words, it gives an indication of the degree of accuracy or quality of finish, etc., which may reasonably be expected from a certain set of moulding conditions and methods.

In addition, it sometimes happens that that degree of quality, etc., which can be consistently maintained in the finished mouldings may come to be regarded as the utmost possible from the operation, when in point of fact a much finer degree of accuracy and uniformity may easily be obtainable.

The setting up of a target of quality below which production must not be permitted to fall, will still leave the way open for modification of such a target as revealed possible in the light of practical moulding and inspection experience over a sufficiently long period.

One further advantage is worth noting in respect of such a target or standard of permissible variation. When the full possibilities of the particular moulding operation and the mould capacity have become fully determined by prolonged working, it is then assured that the production set-up is capable of producing well within a specified average proportion defective.

In order to operate a control chart to such a predetermined standard, which will give indications of the need for corrective action when and if the percentage fraction defective reaches or passes beyond the predetermined average level, suitable control limits will have to be worked out previously. These may be ascertained in the following manner :—

First, lay down the scale of quality level it is desired to apply to the moulding operation. Then determine the size of sampling batches and, finally, the frequency with which such sample sets will have to be taken from production.

As an example, suppose that on a particular moulding it is desired to maintain the quality of the output within, say, 5 per cent. defective as a maximum figure, and groups of 50 components are to be selected once every hour for inspection. Then the number of defective components to be expected, but not exceeded, per sample batch will be :—

$$\frac{5}{1}\times\frac{50}{100}=2.5$$

This value must next be multiplied by the fraction of the components not selected for gauging. Thus, if the set of 50 individual components represents one-quarter of the periodical output, then the figure 2.5 must be multiplied by three-quarters. This would give $\underline{1.9}$.

To obtain the disposition of the control datums on the chart, reference should be made to the tables on page 36 of "A First Guide to Quality Control for Engineers," already mentioned. This will give the figure of 3, and the control limits on the chart should be set accordingly.

If during production the plotted points remain below the control limit thus determined, full confidence may be placed in the surety that the output is being maintained to the stipulated level of quality. Limits thus established, possess the great merit of not requiring any revision or adaptation, and blank charts can be prepared beforehand to cover an exceedingly long production run.

(To be continued)

The Microscopic Examination of Plastic Materials

VII.—Mouldings (Contd.)

By J. H. WREDDEN, F.R.M.S.
(Chief Chemist, Igranic Electric Co., Ltd.)

IN further examining the leather-filled moulding, it is perhaps expedient to look at one of the large resin masses a little more closely. The only difference between the masses met with in this material and those of the previously examined mouldings is the presence of larger bubbles. In Fig. 313, at a magnification of 100 diameters, there are seen to be present many very small bubbles and two large ones. The mass itself, in all probability, originally developed as a void due to gas formation, and commenced to form early in the moulding cycle. In this manner it would reach sizeable dimensions while the resin was still quite liquid and capable of blowing into the space as the gas diffused through the surrounding fibres of leather. This is the probable explanation of the evidence of these larger resin masses, and shows that the degeneration of the leather must occur quite early ; in fact, before the full pressure of the mould is developed. The large bubble might be due to gas from the leather, or, more likely, to the formation of reaction water in the early stages.

As in the normal condition the leather powder is composed of particles possessing a well-defined shape and morphology in general, we should expect normally to be able to distinguish something of this in the structure of the moulding, but due to the destructive effect of heat and pressure, it has been shown that very little of this is distinguishable. However, in certain instances, where the particle was composed of particularly resistant fibres, something of the structure of the particle is capable of being seen. Thus in the general view of a portion of the section seen in Fig. 314 (at 40 diameters) one large leather particle is seen in longitudinal section at A. This particle is seen to curve round and conform to the general shape of the lower border of the large resin mass indicated at B. If this particle is studied further, it will be seen that a portion of the resin mass is enclosed in the structure of the particle ; this is shown at C, where the particle is seen to be separated by the resin mass, the point of bifurcation being indicated by the arrow.

Outside the marked area at D, the leather will be seen to have little, if any, regular structure ; in fact, it will be noticed that there is much evidence of the effect of heat. However, in the case of the particle under consideration, there is some semblance of the fibrous structure originally present. From this it may be

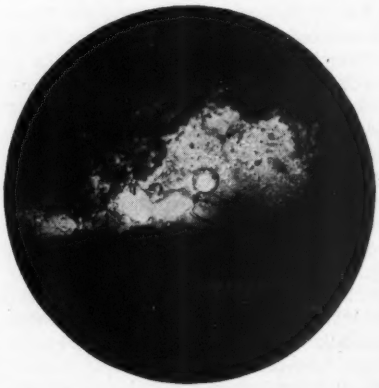


Fig. 313.—Leather-filled moulding showing large resin masses. Mag. 100 diameters.

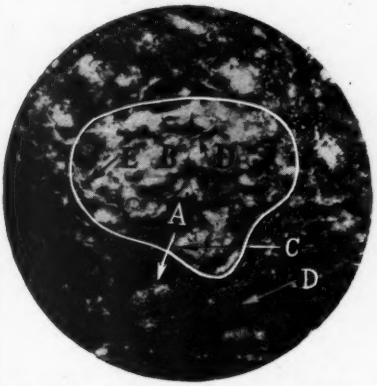


Fig. 314.—Leather-filled moulding : section showing general structure. Mag. 40 diameters.

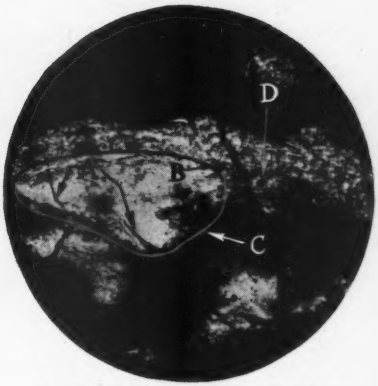


Fig. 315.— Leather-filled moulding : section showing large particle. Mag. 100 diameters.

assumed that the degeneration due to heating is not general, nor by any means complete, but in all fairness it should be mentioned that the leather powder used for this filler was originally made from scrap trimming, and contains many different varieties and grades, not to mention sources of origin. It is not surprising, then, that we find particles in this moulding which have evidently resisted to a greater extent the ravages of the processing to which it has been subjected.

As a result of these effects and the appearance of the numerous resin masses, the strength of the moulding may be expected to suffer. The result of this is apparent in the crazing which occurs, more particularly in the pockets of resin, and numerous cracks of minute dimensions, and sometimes larger, are to be seen. These do not appear to follow any directed course, such as experienced by those in the previous specimens, but pass through and around particles indiscriminately. Two of the larger cracks are seen at D and E, in Fig. 314 where they give the appearance typical of fracture occurring in a homogeneous material under the effect of shrinkage stresses. It will be seen that the presence or absence of leather particles has no influence upon the direction of the fracture ; therefore it must be assumed that internal stresses, set up presumably by shrinkage, are the cause and further, that from the aspect of component strength, this is very much the same for the particles as for the resin pockets.

The gross cracking is very well seen in Fig. 315, which relates to a portion of the same section at a magnification of 100 diameters. In this instance large cracks are seen at A and B, extending right across what appears to be a very large pocket of resin, but in reality the portion composed of this latter is enclosing in the area indicated at C. The remainder of the mass, extending across the photograph, is a single leather particle of the more resistant type. The pocket of resin can be seen to have developed at one end of the particle, probably as a result of one of the causes outlined above. Nevertheless, the chief significance of this illustration lies in the manner in which it demonstrates the fractures to run through clear resin and leather alike, without pause or deviation.

This leads to interesting speculation as to whether this cracking exists in situ in the moulding, or whether it only occurs as a result of making a thin section, and so caused by the relief of residual stress, not possible in the mass in normal circum-

stances. If the former condition is the true one, then the low tensile strength is, in some manner, accounted for, although while reasoning thus it must not be forgotten that a considerable decrease in tensile strength is present, as a result of the partial pyrolysis of the leather. If, on the other hand, the cracking does not exist in the mass, then the low tensile strength is explained by the filler degeneration, and in view of the fractures apparent in this section, it follows that residual stress must be present in the mass, which means that something akin to an annealing process would in all probability be beneficial.

It is not proposed to discuss this particular material at any great length, owing to the improbability of its being of immediate utility on a general scale, but its examination has been of some use, indicating the general behaviour of leather when used as a filler, and the possible results to be expected of animal proteins as a whole. In general, the strong tendency for the formation of resin pockets due to fusing of the filler particles is illuminating, as it is probable that this is an indication of the possible behaviour of any material, whether animal or vegetable in origin, which is either fusible or to some extent soluble under the conditions encountered in the processing of a moulding powder to the final product.

Having thus briefly illustrated the differences to be encountered when animal proteins are used as fillers, it is now proposed to continue our examination of more orthodox mouldings. So far we have dealt with mouldings filled with materials less commonly used, but before proceeding to a study of those filled with the widely-used softwood flour, it is expedient to examine one or two more examples of materials incorporating fillers which are not quite so popular.

For this purpose we cannot do better than examine a coconut-shell flour-filled moulding. This filler, as we already know, produced some unexpected results when it came to be evaluated as such. The mechanical strengths were above

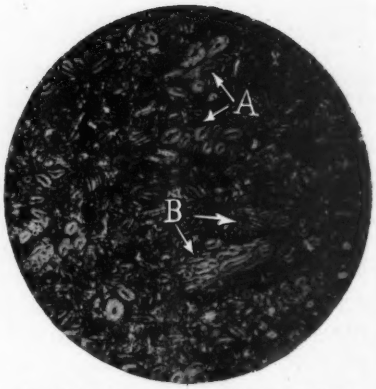


Fig. 316.—Coconut-shell filled moulding: section showing general structure. Mag. 26 diameters.

those expected, in view of the conclusions arrived at regarding the morphology of the filler particle. However, it will be remembered that there appeared to be a considerable portion of available lignin present, which was additional to that present in association with the cellulose. This reactive or native lignin, it was assumed, could in some measure account for the unexpected strength of the material, and subsequent experiment has proved that an additional proportion of hexamine is necessary in the resin formulation in order to produce the maximum strength; otherwise this property would suffer due to the normal formaldehyde content being insufficient, in which case cross-linking could not proceed as far as would normally occur.

Apart from considerations involving the chemistry of the material, there would also appear to be certain factors relating to the particle morphology which might also have an influence on the subject. When discussing the particle morphology, it was pointed out that whereas a great many particles consisted of bundles of elementary tracheids, whose general shape corresponded in some measure to that of the ideal concept, there were also numerous other particles which were almost spherical in shape, and hence not capable of con-

ferring a high degree of strength on the final product. However, in general the filler was shown to be more dense than ordinary wood flour and thus to possess a higher apparent density. This aided "packing down" into the mould cavity, resulting in the production of a moulding with a somewhat denser structure.

On sectioning such a moulding it is immediately seen to be of a more compact structure than those hitherto discussed. This can clearly be seen from Fig. 316, which shows a general view of a section of a coconut-shell filled moulding at a magnification of 26 diameters. However, before discussing this photograph, it must be stated that whereas the previously examined sections were taken from the neighbourhood of the fracture in a standard tensile test specimen, the section seen in Fig. 316 was taken from a standard moisture absorption disc, which was not subjected to any test, but merely allowed to age naturally at room temperature for a period of about three months.

Referring to the illustration, it will be seen that particles appear generally in two aspects, that is to say, either in transverse section, such as those illustrated at A, or in longitudinal section as those seen at B, but even in the latter case the larger of the two particles is seen to be composed of one or two tracheids in transverse section. This is due to the peculiar structure of the coconut-shell, which it will be remembered consists of tracheids varying in shape from a long and slender element to the almost spherical; added to this, the structure of the shell was seen to have little if any directional orientation, as a result of which an interlaced pattern of tracheids existed. However, in the illustration under discussion the majority of the particles visible are in transverse section; this signifies that in this spot at least the coconut-shell particles tend to orientate themselves with their long axes parallel to that of the moulding.

In general the particles will be seen to be of varying sizes, the variations being of considerable magnitude if it is recognized

Fig. 317.—Coconut-shell filled moulding: section showing fibrous particles. Mag. 26 diameters.

that those flour elements which consist of single tracheids are functional particles. Apart from the true shell tracheid, there are also seen to be present particles of a fibrous nature. These are small pieces of the coir fibre forming the external protective coating of the shell proper. We have seen previously that at the external surface of the shell there are groups of tracheids which also possess as part of their structure fibrous elements which eventually become true coir fibre farther away from the surface of the shell. It may therefore be regarded as being in the nature of a transitional zone from shell to fibre. From this it will be appreciated that the cleaned shell will inevitably have small portions of this fibrous material as a part of the structure of the external surface, and therefore the presence of particles such as those illustrated is not surprising.

Fig. 317 also shows the close-packed nature of the material, and it is partly due to this that it is possible to obtain strengths higher than those usually met with, at the same time using reduced resin contents. In consequence of this, the chances of pockets of clear resin developing are very much reduced.

The two illustrations just discussed both show signs of orientation at right angles

Fig. 318.—Coconut-shell filled moulding: section showing tendency for orientation of particles. Mag. 26 diameters.

to that presumed to exist for the particles seen in transverse section. This is more evident in Fig. 318, which gives a general view of another portion of the same section at 26 diameters. If the particles seen in longitudinal section are studied it will be noticed that there is a very distinct tendency to horizontal orientation. This means that there exists a major tendency for horizontal orientation to occur in two directions at right angles to one another, apart from which an appreciable proportion of the particles are orientated horizontally at different angles to that of the main body. Thus it is evident that in these circumstances the conditions are favourable for the production of an interlacing network of particles similar to that encountered in the structure of the native shell.

Apart from this, the most interesting fact which these photographs have brought to light is the manner in which the coconut-shell elements do not appear to have undergone any morphological modifications as a result of having been subjected to the severe conditions encountered in the moulding process. It is evident that this has had very little, if any, effect in this direction. Even in cases of fairly large particles, such as those marked A, and also one marked B, where one would expect to see a certain amount of deformity due to the moulding pressure, there does not appear to have been any deformity whatever, for the bores or cavities of the cells still present the appearance which is so characteristic of the histological element of this shell. This fact is made abundantly clear by a study of those elements seen in transverse section, such as the group marked C.

From these facts the highly resistant nature of this material begins to become apparent, and it would seem as if the whole operation of moulding a powder, using coconut-shell flour as a filler, becomes one which is more a matter of reconstituting the structure of original shell into predetermined shapes rather than using the filler as a diluent and stress-relieving component of the mixture. The resin, of course, takes the place of the original ligneous cement substance laid down by Nature.

This viewpoint gives rise to interesting speculation regarding the distinct possibilities apparent for more closely approaching the original structure by using the disseminated shell in such a form that the powder consisted of nothing but single tracheids or histological elements. That this possibility exists is shown by the structure of the moulding at places between the larger particles, where a number of small units consisting mainly of single elements are bound together in a manner very similar to that encountered in the structure of the shell; one such area is seen at D, but there are many others in existence in this small portion of the section which represents a spot a little over 1/16 inch in diameter.

As this structure appears in what might be termed the interstitial spaces between the large particles, it is clear that these latter are hindering the development of any structure akin to the natural shell, and therefore if the large elements could be eliminated the chances of reproducing this latter would be greatly increased.

As may be imagined, the presence of the

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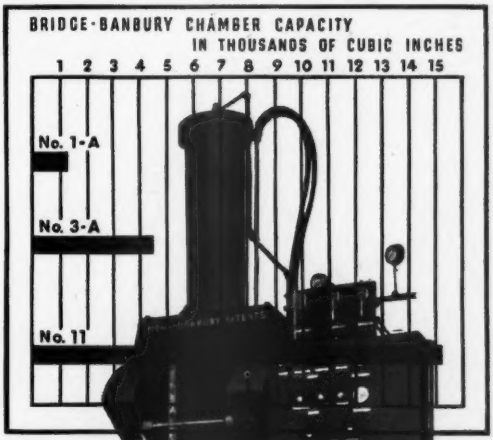

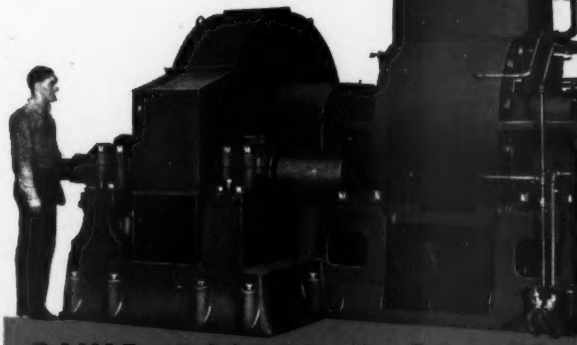

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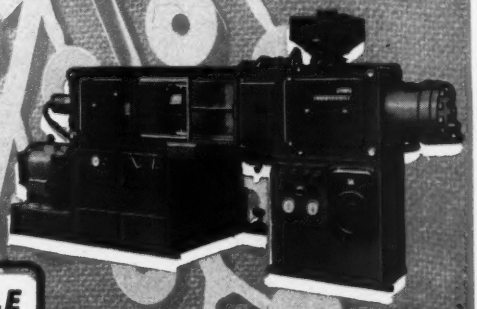

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Fig. 319.—Coconut-shell filled moulding: section showing flow effects. Mag. 40 diameters.

larger particles in the mass of small ones is liable to produce many and varied flow effects in the structure of the moulding. In this particular case these are clearly seen to take various forms. One type is illustrated in Fig. 319, at a magnification of 40 diameters; here the effects of the large particles A, B, C and D are clearly seen. The long axes of these units are so arranged that they tend to form a cross. As a result of this the mass of small particles and resin appears to have been directed into two distinct channels indicated by the arrows. The curious nature of the mass in the centre will be noted; there does not appear to be any general turbulence, as might be expected in the circumstances, but instead, the upper "stream" of material has the appearance of having entered from two sides, D and E, and on meeting at the centre has been deflected upwards in the direction of F.

It must, of course, be realized that this configuration might just as well have occurred in the opposite direction, in which case it would mean that it originated as a single stream entering from F, and on meeting resistance at the point G, became deflected into the two channels on either side, turning it in directions opposite to D and E. Whether this occurs in the one direction or other, it is clear that the assumption presupposes the prior existence of the mass below the dotted line. Furthermore, the probable condition that this mass was in the solidified state, or near to it, at the time, is supported in some measure by the manner in which the line of demarcation between the two masses dips in the middle at G, thus signifying that the lower mass was sufficiently plastic, or fluid, to give way to the extent shown. It will be noticed how the presence of the particle H gives rise to another similar configuration, although on a somewhat reduced scale. Thus another distinct line of demarcation is produced, as indicated by the dotted line I J.

From the foregoing it will be seen that the presence of five large particles, A, B, C, D and H, give rise to the formation of five clear-cut channels, which in turn will result in the curious flow characteristics exhibited. These latter are more or less the expected result of impeding the development of an even pressure throughout the material in the early stages of the moulding cycle, and it is highly probable that the pressure has not had time to distribute itself evenly through the material before solidification commences,

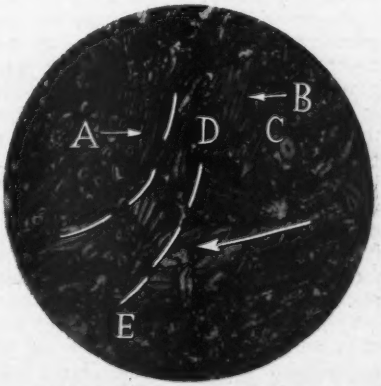

Fig. 320.—Coconut-shell filled moulding: section showing flow effects. Mag. 40 diameters.

with its attendant rise in viscosity and early immobilizing of large filler particles.

In the same way—as was encountered during the examination of the flax shive moulding—the effects of channel formation due to the presence of larger particles in the mass of smaller ones, is seen to be evident as a particle size interaction between the various fractions in the coconut-shell filler. In Fig. 320 we see another portion of the section, at a magnification of 40 diameters. It will be noticed that in this portion the general particle size is somewhat smaller than that seen in the previous illustration; by this is meant that there are no particles of the same size as the large ones encountered in Fig. 319.

There exists, nevertheless, definite evidence of what appears to be directional flow of those particles which may now be called small. This is due to the presence of a few particles slightly larger than the average which appear to have been responsible for the production of channels, although in general this is not quite so marked as in the previous illustration. Thus it will be seen that the three particles A, B and C are so placed as to produce a channel between A, on the one hand, and B and C, on the other hand. The flow could possibly have taken place in the direction indicated.

The presence of particle C seems to have produced a curious configuration of the structure at this point for, from the general appearance of the structure seen in this photograph, it appears likely that the channel was originally formed by the particles A and B, and that particle C was swept down along with the stream until it reached its present situation, where, not being able to pass through the channel, it stopped. In this way it is responsible for causing blocking and a subsequent re-direction of the mass behind it.

This assumption is given some measure of support by the appearance of a line of demarcation situated at the dotted line D E, which is clearly distinguishable, for on the left of the dotted line the particles are seen to be strongly orientated in a

Fig. 321.—Coconut-shell filled moulding: transverse section taken adjacent to surface of moulding. Mag. 26 diameters.

direction parallel to the long axis of the channel. The particles to the right of the dotted line, however, are seen to be in what might be termed a state of "confusion," just as if they had been brought up short by the wall of particles to the left.

Whether this is due to the earlier immobilization of this latter mass or not is not exactly clear, because if the one was moving rapidly a similar effect could be produced; nevertheless, it must be borne in mind that there exists the possibility of masses early becoming immobile and more solid than the surrounding material, due to differences in particle size resulting in local increases in viscosity throughout the structure. This is, of course, apart from the possibility of early cure resulting from different portions of the mass possessing different thermal conductivities. This is not to be confused with the initial curing which takes place at the mould faces, due to the heat being applied externally.

As can be imagined, the quick curing of the resin at the mould faces results in divers effects in consequence of the sudden and rapid liquefaction occurring at this surface. Whereas in the internal mass of the material the filler particles are relatively slow-moving in a comparatively highly

viscous fluid, those at the surface may be considered to be much more mobile, and some degree of verification of this is to be seen when the surface is examined in transverse action as shown in Fig. 321, at a magnification of 26 diameters.

In this illustration the surface is seen as the edge E, and it immediately becomes apparent that there was a considerable degree of turbulence at this point, before solidification occurred; furthermore, the onset of setting was much more rapid than appeared to be the case internally, as evidenced by the manner in which the turbulence seems to have been fixed. Thus in this case the whole pattern may be considered to have been originated by the presence of the particle marked C, lying very close to the surface. This seems to have resulted in an uprush of the fluid mass containing the smaller particles and resulting in the formation of a vortex along the line A B, which is clearly seen if the direction of the orientation of the particles along this line is studied.

The immediate and expected result of this vortex coming into operation is seen in the manner in which the surrounding material has tended to be pulled in. Thus there is a distinct curved orientation along G F and also H I, and it will be noticed that this has occurred at points almost at the surface. Bearing in mind the fluidity of the material at this point, and, in fact, everywhere at the surface, the appearance of vortices similar in nature to the one illustrated is not unexpected when the presence of large filler particles is taken into consideration. However, as we shall subsequently see, when these latter are situated at or near the surface, they do not always result in the production of vortices, but various other effects are noticeable; but there does not seem to be any doubt that in the case of the coconut-shell filler, where the particles do not appear to be affected by morphological distortion, the material is more suited to such phenomena than would be the case with, say, softwood flour.

(To be continued.)

Plastics Researches in the U.S.A.

THE annual report of Mellon Institute, 1947-48, in the U.S.A., shows that work on plastics, which was on wartime intermission, has now been resumed.

Extensive studies of vinyl resin solutions, as part of the work of the fellowship sustained by the Carbide and Carbon Chemicals Corporation, have led to significant improvements in durable white finishes for refrigerators and other home appliances. The announcement of a more compatible grade of resin opens up new fields for copolymer vinyl resins. Improvements have also come from the continuous research on vinyl dispersions. Evolved originally by the demands of war, the wash primer based on vinyl-butyral resin has been reformulated for industrial maintenance applications.

A series of new synthetic resins (the Stypols), investigated by the fellowship of the H. H. Robinson Co., appears to have large potential uses. The new products are clear transparent liquids that may be converted into solid plastics by addition polymerization. Four resins, varying in physical properties from soft and flexible to very hard materials, are now being prepared in pilot plant quantities. The thermosetting nature of these products, and the fact that they contain no unpolymerizable volatile substances, renders them particularly attractive as supplements to thermoplastic waxes and bituminous materials for impregnating and encasing electrical equipment.

The fellowship supported by the Corning Glass Works, in co-operation with the Dow Corning Corporation, is investigating the applications of some of the organosilicon compounds. Organosilicon fluids have been found effective in stopping the "silking" or "floating" of pigments in paints. A method of emulsifying organosilicon anti-foam compounds for aqueous solutions has been devised in which the full potency of the product is retained. Resins now available to paint formulators have been employed as bases for coatings capable of withstanding temperatures beyond the range of durability of organic finishes. Silicone resins have made it possible to meet the severe specifications for dry-type electrical transformers for use in underground mine service.

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

B.P. 599,098. Application date: 13.9.45. Accepted: 4.3.48.

Polymerization Process. R. G. R. Bacon. To: Imperial Chemical Industries, Ltd.

Manufacture of polymers by polymerizing water-soluble olefinic compounds containing a vinyl group (acrylonitrile) in the presence of water-soluble ceric salts and a water-soluble bisulphate.

B.P. 599,138. Application date: 12.3.45. Convention date (U.S.A.): 11.3.44. Accepted: 5.3.48.

Improvements in Moistureproof Polyvinyl Chloride Films. M. R. Radcliffe. To: The Firestone Tire and Rubber Co.

Polyvinyl chloride film of greatly enhanced moisture vapour resistance, containing 0.5-3.0 per cent. of a dialkyl ether (dimyristyl ether, dicetylether or distearyl ether) as moisture transmission inhibitor.

B.P. 599,174. Application dates: 19.9.45; 31.10.45; 20.11.45; 28.2.46. Accepted: 5.3.48.

Process for the Production of Non-rigid Containers Filled with Liquids or Pastes. L. Rado.

Production process for thermoplastic containers filled with liquids or pastes. A thermoplastic type of tubing (p.v.c.) is filled with liquid or paste, and pressure is subsequently applied laterally to the tubing walls at distances equal to the length of a single container to displace the contents of the tubing from the places where pressure is applied. Sealing is effected by heat and pressure (welding); the sealed containers are afterwards cut off. Typical examples of such containers are described in B.P. 599,183 and 599,184. The preferred method of welding is H.F. welding.

B.P. 599,183. Application date: 28.2.46. Divided out of 599,174. Accepted: 5.3.48.

Collapsible Tube-like Package for Liquids or Pastes. L. Rado.

Collapsible container made of a thermoplastic material (p.v.c.) by welding. The neck of the container is provided with a self-sealing aperture for expulsion of the liquid or semi-liquid contents by application of pressure on the tube wall. The tube neck is bendable, and is pierced by a pointed tool to allow the escape of the liquid contents of the tube.

B.P. 599,184. Application date: 19.9.45. Divided out of B.P. 599,174. Accepted: 5.3.48.

Collapsible Tube-like Container for Liquids or Pastes. L. Rado.

Very similar to 599,183.

B.P. 599,193. Application date: 1.1.45. Accepted: 8.3.48.

Method of and Apparatus for Electrically Treating Material. H. H. G. Grell.

Electrode systems for application of H.F. heating. Multiple stationary electrodes, rotary systems of electrodes, specially shaped electrodes.

B.P. 599,203. Application date: 11.6.45. Convention date (U.S.A.): 11.5.44. Accepted: 8.3.48.

Improvements in or relating to Adhesive Waterproof Compositions. To: The Patent and Licensing Corporation.

An adhesive waterproof composition comprising a normally solid asphalt base and additions of cetyl acetamide wax and not more than 12 per cent. by weight of polyisobutylene.

B.P. 599,239. Application date: 14.11.45. Convention date (U.S.A.): 16.11.44. Accepted: 8.3.48.

Improvements in or relating to Elastomeric Materials. To: Imperial Chemical Industries, Ltd.

Improving the processing characteristics of butadiene styrene elastomers by incorporating 0.5–5 per cent. of a zinc salt of xylyl mercaptan.

B.P. 599,277. Application date: 20.7.45. Convention date (U.S.A.): 20.9.44. Accepted: 9.3.48.

Composition of Vinyl Copolymers. G. R. Penn, J. F. Suter, R. W. Quarles. To: Carbide and Carbon Chemicals Corporation.

Lacquer-like coating composition comprising an organic solvent, a vinyl copolymer (vinylchloride-acetate-alcohol or vinylchloride-acetate alcohol-maleic acid: and a film-forming ingredient (vegetable oils, thermo-setting resins, etc.).

B.P. 599,278. Application date: 20.7.45. Accepted: 9.3.48.

Improvements in Dyes and in Coloured Fibres, Foils and Films. H. C. Olpin, K. R.

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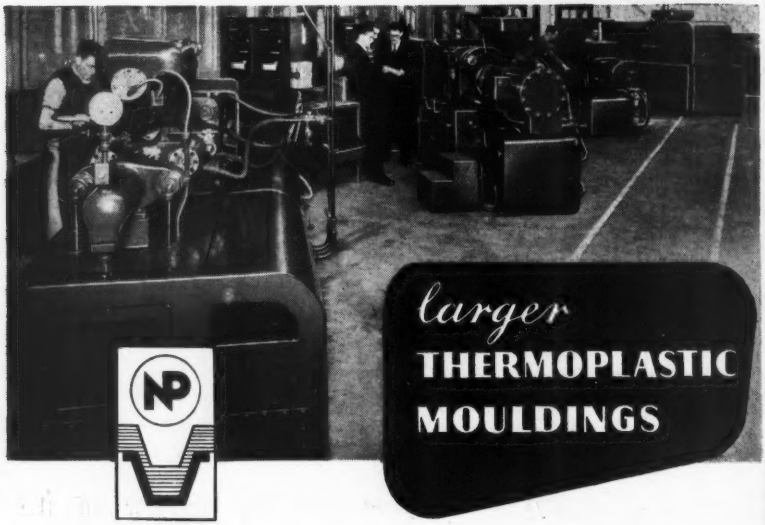

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House and J. Wright. To: British Celanese, Ltd.

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B.P. 599,298. Application date: 20.10.45. Convention date (U.S.A.): 21.6.45. Accepted: 9.3.48.

A New or Improved Electrostatic Bonding Machine. To: The Singer Manufacturing Co.

Reciprocating-bar high-frequency welding machine.

B.P. 599,342. Application date: 15.9.45. Convention date (U.S.A.): 23.9.44. Accepted: 10.3.48.

Improvements in or relating to the Adhesive Bonding of Shoe Parts. F. V. Nugent. To: B.B. Chemical Co. Ltd.

Bonding of shoe parts by applying a synthetic rubber cement to the surfaces to be bonded, spraying one of the rubber surfaces with an activator for the cement (toluene, acetone or methyl-ethyl-ketone) and pressing the parts together. The cement may consist of polymerized chloroprene or a copolymer of butadiene and acrylonitrile.

B.P. 599,378. Application date: 31.10.44. Accepted: 11.3.48.

Improved Polymerization Process. To: Standard Oil Development Co.

Low-temperature polymerization of olefines (mixture of a tertiary mono-olefin and a di-olefin). An alkyl halide is used as diluent.

B.P. 599,390. Application date: 18.5.45. Convention date (France): 22.5.44. Accepted: 11.3.48.

Method and Apparatus for the Manufacture of Sheets of Polymerized Material. J. Doucerain.

Relates to the manufacture of sheets from the monomers of acrylic, methacrylic, vinyl or styrene resins by exposing a continuous stream of these liquids on a conveyor band to the action of heat and/or light.

B.P. 599,417. Application date: 2.11.45. Convention date (U.S.A.): 16.11.44. Accepted: 11.3.48.

Improvements in the Production of Artificial Filaments and other Shaped Articles. To: British Celanese, Ltd.

B.P. 599,429. Application date: 21.5.43. Accepted: 12.3.48.

Improvements in or relating to Polymerization Reactions. J. J. P. Staudinger, C. A. Brighton, D. A. Bennett and D. Faulkner. To: Distillers Co., Ltd.

Stabilization of vinyl or vinylidene compounds by incorporating lead acetate, lead-beta hydroxy butyrate, lead acrylate (or methacrylate), lead succinate, maleate, laurate, stearate or perchlorate.

B.P. 599,437. Application date: 12.12.44. Accepted: 12.3.48.

Improvements in or relating to High Molecular Weight Polymeric Materials. To: Standard Oil Development Co.

Low-temperature polymerization of olefines (mixture of isobutylene, styrene and isoprene).

B.P. 599,442. Application date: 2.5.45. Accepted: 12.3.48.

An Improved Manufacture of Hydrocarbon Copolymers. To: Standard Oil Development Co.

Low-temperature polymerization of an iso-olefin (isobutylene) and a di-olefin (2-methyl hexadiene-1.0; 2-methyl pentadiene 1,4, etc.).

B.P. 599,460. Application date: 17.1.45. Convention date (U.S.A.): 17.1.45. Accepted: 12.3.48.

Laminated Wrapping and Bagging Sheet Material. To: Dearborn Chemical Co.

B.P. 599,472. Application date: 18.9.45. Accepted: 12.3.48.

Improved Method of Polymerization. M. C. Ashworth, R. G. R. Bacon and L. B. Morgan. To: Imperial Chemical Industries, Ltd.

Polymerization of ethylenic substances in the presence of a water-soluble persulphate and a water-soluble salt of an oxy-acid of sulphur having reducing properties and a water-soluble metal salt, for instance, copper sulphate.

B.P. 599,484. Application date: 6.8.46. Patent of addition to B.P. 599,437. Accepted: 12.3.48.

An Improved Manufacture of High Molecular Weight Hydrocarbon Polymers. To: Standard Oil Development Co.

Modification of the process claimed in B.P. 599,437. The tripolymer formed is mixed with a curing agent (sulphur), an accelerator, etc., and cured.

B.P. 599,488. Application date: 18.11.43. Convention date (U.S.A.): 22.10.42. Accepted: 15.3.48.

Improvements in or relating to Unsaturated Compounds and Polymers thereof. To: Pittsburg Plate Glass Co.

Preparing an ester amide by treating a sodium derivative of an unsaturated carboxylic acid amide or of an unsaturated ester of carbamic acid with a polychloroformate of ethylene glycol.

B.P. 599,492. Application date: 19.7.44. Convention date (U.S.A.): 15.6.43. Accepted: 15.3.48.

Improvements in or relating to Impregnating Compositions and to Materials impregnated therewith. H. Snow.

Thermosetting liquid for impregnating fabric to render it water- and wear-resistant, consisting of a reaction product of phenol-formaldehyde, pitch, a polymerized olefinic hydrocarbon, a drying oil and a petroleum distillate solvent.

B.P. 599,522. Application date: 6.11.45. Convention date (U.S.A.): 9.11.44. Accepted: 15.3.48.

Improvements in and relating to Methyl Polysiloxane Compositions. To: British Thomson-Houston Co., Ltd.

B.P. 599,523. Application date: 26.9.45. Convention date (U.S.A.): 27.9.44. Accepted: 15.3.48.

Production of New and Improved Compositions Comprising Vinyl Chloride Polymers. To: E. I. Du Pont de Nemours and Co.

Refers to vinyl chloride-vinyl acetate-diethyl fumarate copolymers and similar products.

B.P. 599,528. Application date: 26.9.45. Convention date (U.S.A.): 28.9.44. Accepted: 15.3.48.

Improvements in or relating to Dielectric Heating Apparatus for the High-frequency Heating of Dielectric Material. To: Westinghouse Electric International Co.

B.P. 599,529. Application date: 26.9.45. Convention date (U.S.A.): 28.9.44. Accepted: 15.3.48.

Improvements in or relating to Dielectric Heating Apparatus for the High-frequency Heating of Dielectric Material. To: Westinghouse Electric International Co.

B.P. 599,530. Application date: 26.9.45. Convention date (U.S.A.): 28.9.44. Accepted: 15.3.48.

Improvements in or relating to Dielectric Heating Apparatus for the High-frequency Heating of Dielectric Material. To: Westinghouse Electric International Co.

B.P. 599,546. Application date: 17.8.43. Accepted: 16.3.48.

Improvements in or relating to Coating Compositions. To: Hercules Powder Co.

Relates to coating compositions containing pentaerythrol, polypentaerythrol and polypentaerythrol esters of resin or modified resin and an alpha-beta unsaturated polybasi acid.

B.P. 599,555. Application date: 17.5.45. Accepted: 16.3.48. Convention date (France): 28.6.43.

Method of Manufacture of Synthetic Resin Articles by Polymerization. J. Doucerain.

Manufacture of articles from liquid monomers (acrylic, methacrylic or vinyl resins) by progressive polymerization of these liquids in moulds either by gradual and systematic displacement of the polymerization-promoting agent or by projecting a beam of rays on to the mould and progressively changing the direction of the beam.

B.P. 599,570. Application date: 18.9.45. Accepted: 16.3.48.

Improvements in Methods and Apparatus for Injection Moulding of Thermoplastic Materials. A. Cretin. To: Thurgar, Bolle, Ltd.

Refers to the injection moulding of cellulose acetate.

B.P. 599,580. Application date: 19.9.45. Convention date (U.S.A.): 20.9.44. Accepted: 16.3.48.

Process for the Production of new and useful Porous Articles consisting essentially of Polymers of Tetrafluoroethylene. To: E. I. Du Pont de Nemours and Co.

B.P. 599,668. Application date: 27.2.40. Accepted: 18.3.48.

Improvements in or relating to the Extrusion of Thermoplastic Compositions so as to obtain Artificial Filaments, Films, Foils and like Shaped Articles. H. Dreyfus.

B.P. 599,669. Application date: 2.4.40. Accepted: 18.3.48.

Improvements in or relating to the Production of Artificial Filaments, Foils and like Shaped Articles. R. W. Moncrieff and C. W. Sammons. To: British Celanese Ltd.

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B.P. 599,670. Application date: 5.8.40 and 2.12.40. Accepted: 18.3.48.

Improvements in or relating to the Production of Artificial Filaments, Films and like Materials. H. Dreyfus.

B.P. 599,671. Application date: 19.9.40. Accepted: 18.3.48.

Improvements in or relating to the Production of Compositions having a Basis of Synthetic Fibre- or Film-forming Organic Substances. R. W. Moncrieff, C. W. Sammons and E. W. Wheatley. To: British Celanese, Ltd.

Refers to the spinning of polyamides.

B.P. 599,683. Application date: 4.7.44. Convention date (U.S.A.): 6.10.42. Accepted: 18.3.48.

Improvements relating to the Manufacture and Utilization of cold-setting Polyhydric Phenolic Aldehyde Adhesives. P. H. Rhodes.

Method of bonding two or more members by applying a coating of a liquid resorcin-aldehyde adhesive, treating the members prior to union with a setting agent (formaldehyde, polymethylolphenol or its sodium salt).

B.P. 599,701. Application date: 5.4.45. Convention date (France): 11.10.43. Accepted: 18.3.48.

Improvements in or relating to the Manufacture of Seamless Hollow Articles from Natural or Synthetic Rubbers. C. Saint Mieux. To: Societe Meridionale du Cautchouc Someca.

Dipping goods from natural or synthetic dispersions using polyvinyl alcohol formers which are subsequently softened, dissolved or disintegrated by contact with water.

B.P. 599,702. Application date: 13.4.45. Convention date (France): 14.4.44. Accepted: 18.3.48.

Method of Preparation of Melamine. To: Produits Chiniques de Ribecourt.

B.P. 599,782. Application date: 16.11.45. Accepted: 19.3.48.

Improved Moulds for Casting Synthetic Resins, for example for Optical Elements. M. H. Silber, W. A. Greenwood and C. H. Crooks. To: Imperial Chemical Industries Ltd.

B.P. 599,792. Application date: 18.2.44. Convention date (U.S.A.): 11.1.43. Accepted: 22.3.48.

Improvements in or relating to Methods of Cast Polymerization. To: Pittsburg Plate Glass Co.

Casting of articles by polymerizing organic compounds containing two or more polymerizable groups, by heating the compound in the presence of a catalyst in moulds lined with a soft elastic material (polyisobutylene or butadiene copolymers).

B.P. 599,794. Application date: 14.4.44. Convention date (U.S.A.): 7.5.43. Accepted: 27.3.48.

Improvements in or relating to Light-polarizing Material and Manufactures thereof. To: International Polaroid Corporation.

Manufacture of light-polymerizing material from a molecularly oriented sheet comprising a linear poly-vinyl oxy compound by staining the sheet with an iodine-containing solution, subsequently removing from the sheet part of the staining solution.

B.P. 599,837. Application date: 1.8.45. Accepted: 22.3 48.

The preparation of New Polymerisable Organic Materials and Polymers and Copolymers thereof. F. J. H. Mackereth. To: Imperial Chemical Industries, Ltd.

B.P. 599,893. Application date: 25.10.45. Accepted: 23.3.48.

Improved Means for Feeding High-frequency Electric Currents to the Electrodes of Heating Apparatus. J. C. Quaile and P. Jones. To: British Insulated Callenders Cables, Ltd.

Resonant-line output circuit coupled to work electrodes by means of rigid rings which can be displaced laterally along the transmission line; suitable for frequencies up to 200 Mc/s.

Roller electrode with two conducting rings separated by insulating material.

B.P. 599,894. Application date: 25.10.45. Accepted: 23.3.48.

Improvements in Machines for forming Sheet Materials by the Heating Effect of Electric Stress Alternating at High Frequency. J. C. Quayle and P. Jones. To: British Insulated Callenders Cables, Ltd.

Scheme of H.F. roller welder based on B.P. 599,893, using double-electrode wheel as bottom roller and plain metal disc as top roller. Automatic adjustment for variation in load capacity. Speed, RF output and correct inter-relation are controlled by pedal.

B.P. 599,898. Application date: 14.11.45. Accepted: 23.3.48.

Improvements in Machines for Joining Sheet Materials by the Heating Effect of Electric Stress Alternating at High Frequency. J. C. Quaile, P. Jones and H. A. Nancarrow. To: British Insulated Callenders Cables Ltd.–B.X. Plastics Ltd.

Detailed design of H.F. roller-welder according to B.P. 599,983 and 599,984.

B.P. 599,905. Application date: 2.10.46. Patent of addition to B.P. 585,205. Accepted: 2.4.48.

Curing Polymeric Materials. D. A. Harper and W. F. Smith. To: Imperial Chemical Industries Ltd.

Refers to the curing of aromatic tri-isocyanate modified polyester amides.

B.P. 599,921. Application date: 2.2.45. Accepted: 24.3.48.

Improvements in Moisture-Vapour-proof Pouches. C. P. Olstad.

Moisture-vapour-proof tobacco pouch, consisting of an outer transparent lamination and an inner pigment-coated surface. The laminations are held together by a tacky non-solidifying moisture-vapour-proof adhesive, and are coated on their outward faces with a moisture-vapour-proof heat-sealable material. The composite sheet is being folded and the edges heat-sealed.

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*Transfer Moulding—Feeds**

No exact figures are available, but experience has shown that the energy absorbed in a feed is related to the length of that feed, so long as the flow is maintained in a free state. It has been found that, using water flow formula as a basis, the loss of energy due to friction is related to the *n*th power of the diameter of the feed, the factor *n* varying between 5 and 9, depending on the elements of the formula. Hence, diameter should have a greater effect on flow than length. As both elements have a direct and simultaneous bearing on friction, it will be realised that a feed, say 4-in. in length, must have a diameter (or other cross-sectional dimensions) many times that of a feed 2-in. in length; this comparison is illustrated in Figs. 1 and 2. Judging by water flow, the ratio of the diameter to the length can be as high as 9 which emphasizes the importance of keeping feeds short in length as a first step towards correct transfer moulding.

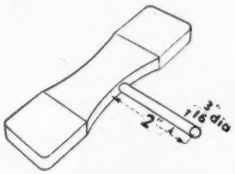

Fig. 1

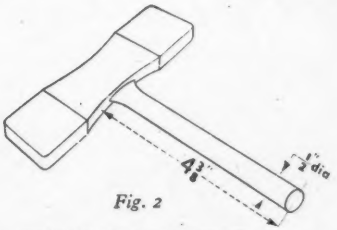

Fig. 2

* *Although the subject of feeds is not new to this series, this note serves to emphasize points previously mentioned as the subject is one aspect in transfer moulding which is probably least understood.*
It has been dealt with in greater detail in the Beetle Magazine No. 19, *Vol.* 2, *copies of which we shall be glad to forward, free on request.*

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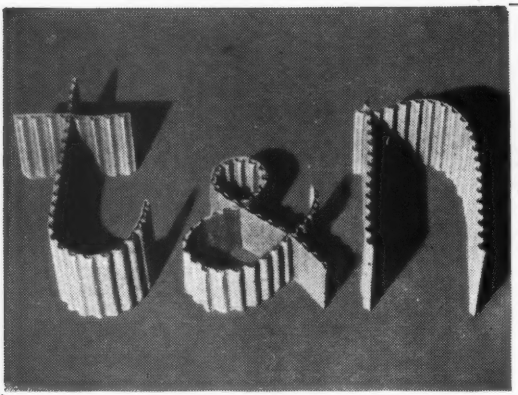

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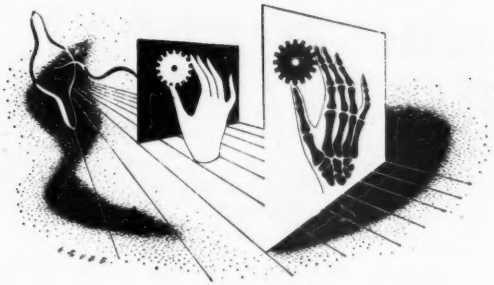

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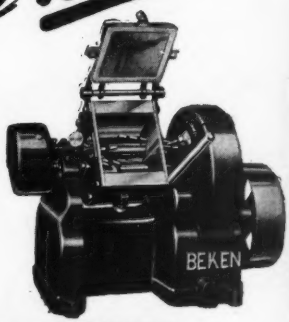

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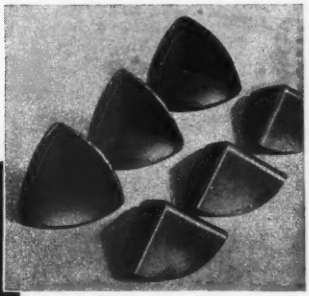

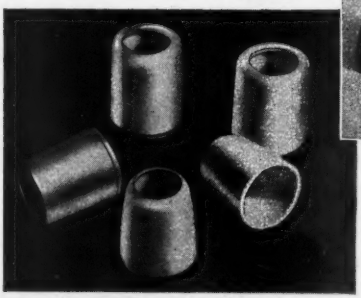

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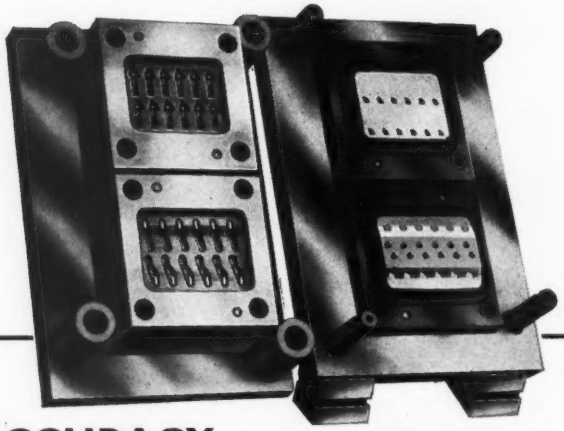

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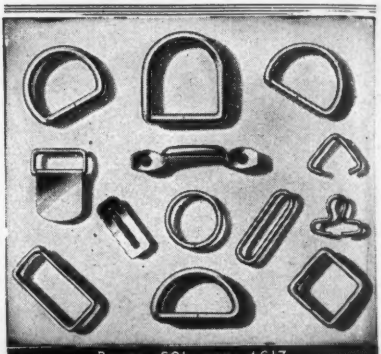

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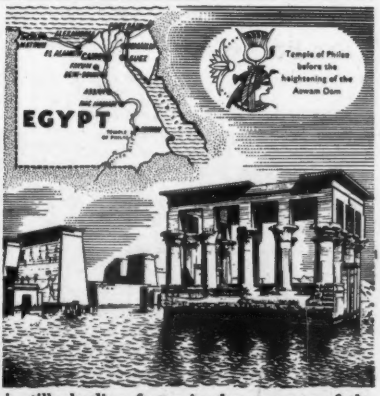

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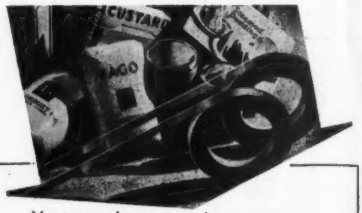

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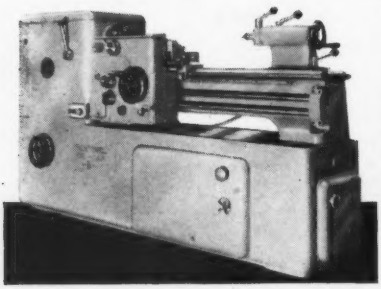

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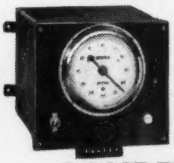

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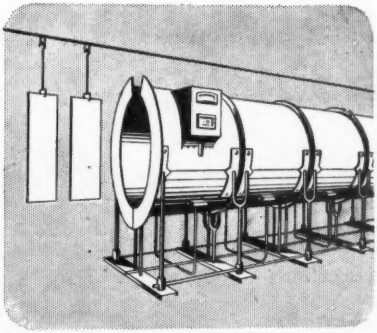

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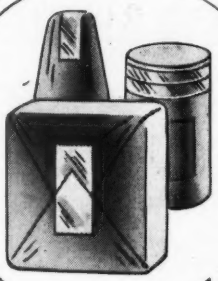

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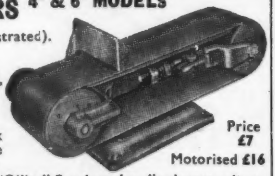

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Acetate and celluloid transparent sheeting from 1s. 6d. per lb.
Coloured transparent and opaque celluloid and acetate sheeting from .007 in. to .120 in., from 3s. 9d. per lb. Crystal acetate, 2, 3, 4. 5 and 6 mm., from 5s. 6d. per lb. Full-size sheets.
Large stock of various plastic materials suitable for lamp shade, toy makers and upholsterers, etc.
Samples and stock list on request. 135-24
Materials for sale. Cellulose acetate moulding powder, virgin and reground. Sheets various colours and thicknesses. Polystyrene moulding powder, virgin, various colours. P.F. black moulding powder. P.V.C. sheeting: Box 4751, care of "Plastics." 135-27
Advertiser has approx. 3 cwt. of .010-in. Dufay Chromex and approx. 33 lb. of .001 Clarifoil for disposal. Offers invited. Box 5315, care of "Plastics." 136-x4624
Manufacturers require small or large quantities of clear Perspex offcuts ⅛ in. or 5/32 in. thick and sufficiently large to cut strips approx. 7 in. by ¾ in. Advertiser, 47 Stoney Lane, Birmingham, 12. 135-x4480
Perspex scrap (coloured) available in 1-5-ton lots. Write Box 5310, care of "Plastics." 135-3
Dibutyl phthalate, dioctyl phthalate, dimethyl phthalate. Stocks for sale. Box 5308, care of "Plastics." 135-5
Crinothene and thonging to match, all colours. Handicraft felt squares in 16 colours. Hitchcock and Earle, Ltd., 26 Grove Road, Worthing, Sussex. 135-7
Warerite black, blue and cream, sheets 48 by 48 by ⅛, matt finish one side, available for immediate delivery. Write Box 5311, care of "Plastics." 135-4
Wanted, Perspex panels curved or flat, thicknesses ⅛-in. to ¾-in., in regular pieces, 1 sq. ft. minimum. Reply to Box 5300, care of "Plastics." 135-9

Raw Material Available and Wanted (contd.)

Bakelite rod, ¼ in., 5-16 in., ¾ in., 1 in. and 1⅛ in. diameter, at greatly reduced prices to clear. Phone, Edg 7061. 135-14

Four tons high-grade imported black phenolic moulding powder, immediate delivery. Box No. E 302, Streets, 110 Old Broad Street, E.C.2. 135-15

Flat Perspex sheets, clear, coloured, 54 ins. by 48 ins., or cut sizes; corrugated Perspex roof lights; aluminium, alloy and plastic sheeting and mouldings. Henry Moat and Sons, Ltd., Atom Works, Newcastle. 135-16

P.V.C. sheet cuttings. Quick delivery, sorted as requested. Box 5342, care of "Plastics." 136-372

Catalin off-cuts required, particularly cylinders and sheet. Send details. Box 5312, care of "Plastics." 136-371

Perspex acrylic sheet.
Large range of colours from 1-16 in. to ½ in. Large stocks, good delivery.
J. H. Berry (Plastics), Annesley Woodhouse, Notts. Phone, East Kirkby 2151. 140-569

Methyl methacrylate scrap is wanted for import to Norway. We are also interested in renting injection and pressing moulds on good terms. Nordisk Formstoff, Tollbugt, 30, Oslo, Norway. 136-367

SITUATIONS VACANT

None of the vacancies in these columns relates to a man between the ages of 18 and 50, inclusive, or a woman between the ages of 18 and 40, inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1947, or the vacancy is for employment excepted from the provisions of that Order.

Young mechanical engineer to be trained as assistant to the technical manager required by North-west plywood factory. State qualifications, previous experience and salary expected. Box 4752, care of "Plastics." 136-307

Rubber chemist required by large general rubber goods manufacturers in Manchester area, experience in development and analytical work is required, and some knowledge of plastics would be an advantage. Write, giving details of age, experience and qualifications to Box 5307, care of "Plastics." 136-370

Representative required by London firm of Plastic moulders, applicants should be of good appearance, knowledge of shipping houses and export trade an advantage, preference given to ex-Serviceman, must be prepared to travel to all parts of the country. Send full details in confidence to Box 5305, care of "Plastics." 135-19

Manufacturer of quality all-welded plastics rainwear, leather goods, fancy goods, etc., requires reliable agents for Scotland, Manchester and North of England, Birmingham and the Midlands, London, S. Wales and S.W. England and N. Ireland. Applicants should have good connections with wholesalers in their area and up-to-date knowledge of the marketing of plastics. Box 5309, care of "Plastics." 135-18

Well-established company, developing comparatively new plastic moulded engineering and friction materials require first-class production engineer to take sole charge of department, candidates should possess qualifications at least equal to A.M.I.Mech.E. standard, salary will be commensurate with experience and qualifications, and the position is one offering real scope for initiative, applications with full details of past experience and qualifications should be sent to Box 5301, care of "Plastics." 135-10

Required for Birmingham area, experienced assistant capable taking charge of sales organization and office routine, general plastics knowledge desirable, salary in accordance with experience. Box 5306, care of "Plastics." 135-6

Situations Vacant (contd.)

Representative required for London and Home Counties area with thorough knowledge and connections in the plastics moulding powder and scrap trade, only applicants who fulfil the above conditions need apply. Remuneration on a basis of salary, commission and expenses. Box 5313, care of "Plastics." 135-2

Travellers and agents required, all parts British Isles, calling on hotels, restaurants, etc., to sell attractive line on commission basis. Box 4945, care of "Plastics." 135-x3328

SITUATIONS WANTED

Moulding shop foreman, 19 years' practical experience compression and injection, seeks situation, home or abroad, excellent references. Box 4652, care of "Plastics." 135-x2373

South America. Director of chemical company sailing late summer is prepared to undertake addition commissions. Box 5325, care of "Plastics." 135-21

Moulding shop foreman seeks change, 23 years' practical experience in compression moulding, also injection and transfer. Distance no object if accommodation available. Box 5122, care of "Plastics." 135-x4014

Enterprising salesman, 29, proven sales record, requires position of responsibility with leading plastics manufacturer, highest references. Box 5121, care of "Plastics." 135-x4015

TIME RECORDERS

Factory time recorders. Service rental. Phone, Hop 2239. Time Recorder Supply and Maintenance Co., 157-159 Borough High Street, S.E.1. 137-3686

MISCELLANEOUS

Plastic cement for use with Perspex Acrylic sheets, Grade I, available in large or small quantities, clear and coloured. Trade inquiries from Evolite Plastics, Ltd., 325 Latimer Road, London, W.10. Phone, Lad 1879, " 1138-04011

Engraved name plates, scales, dials, etc., supplied. Tickets and Co., Box 2, Silver Street Leicester. 141-5699

Extend Your Trade.
Use a Trade Mark. Consult
Trade Mark Protection Society
12 Church Street, Liverpool. 142-6036

Huts, Nissen-type, 24 ft. span and 16 ft. span, any length; also other industrial buildings, suitable for workshops, stores, garages, canteens, site office, club halls, etc., no acquisition licence required. Write phone or call for details. J. Thorn and Sons, Ltd., Box 138, Brampton Road Bexleyheath, Kent. Phone, Bexleyheath 305. zzz-204

New Plastic Devices for education, office, stores, games, pools, advertising. Novel containers for sample products, confectionery, etc. Manufacture and distribution offered progressive firm. Write Box 4537, care of "Plastics." 135-x1939

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HAMILTON LANE, HAMILTON PARK,
LONDON, N.5. 137-376

Photography by Behr will show your products at their best. Ask for illustrated list. 44 Temple Fortune Lane, London, N.W.11. Speedwell 5298. 145-312

Screws! Screws! Screws! We have immense quantities of all types of BA screw available for immediate disposal. Box 4750, care of "Plastics." 135-308

For sale, 2 single-impression saucer moulds, 2 single-impression tea plate moulds, in new condition, chromium-plated. Write Box 1816, Williams's Advertisement Offices, Bradford. 135-x3860

Waterproof inks for plastics in all colours for spray and hand brush. Free samples from Lakeland Ink Co., 98 Ocean Road, Barrow-in-Furness. 137-x4383

Monomarks. Permanent London address. Letters redirected, 5s. p.a. Write, Monomarks, BCM/MONO76, W.C.1. 140-373

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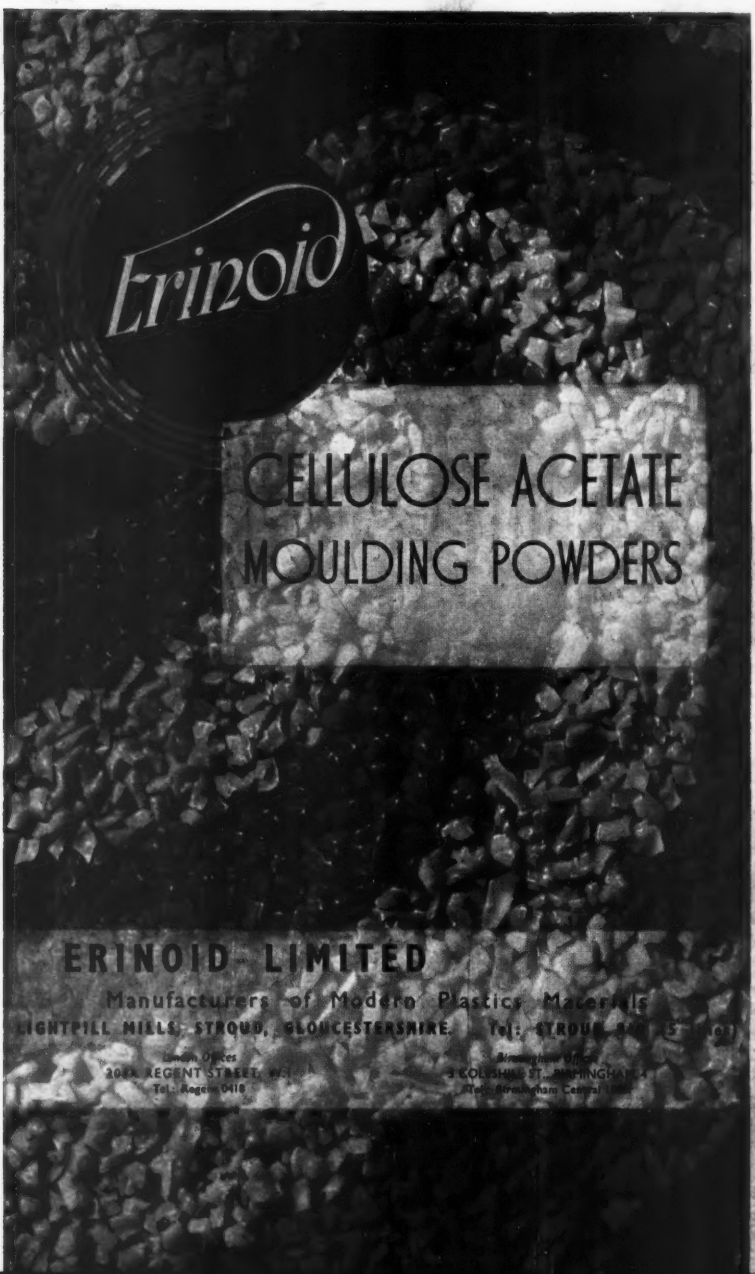

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